Fumee Creek Watershed Project Management Plan

2003

Dickinson Conservation District
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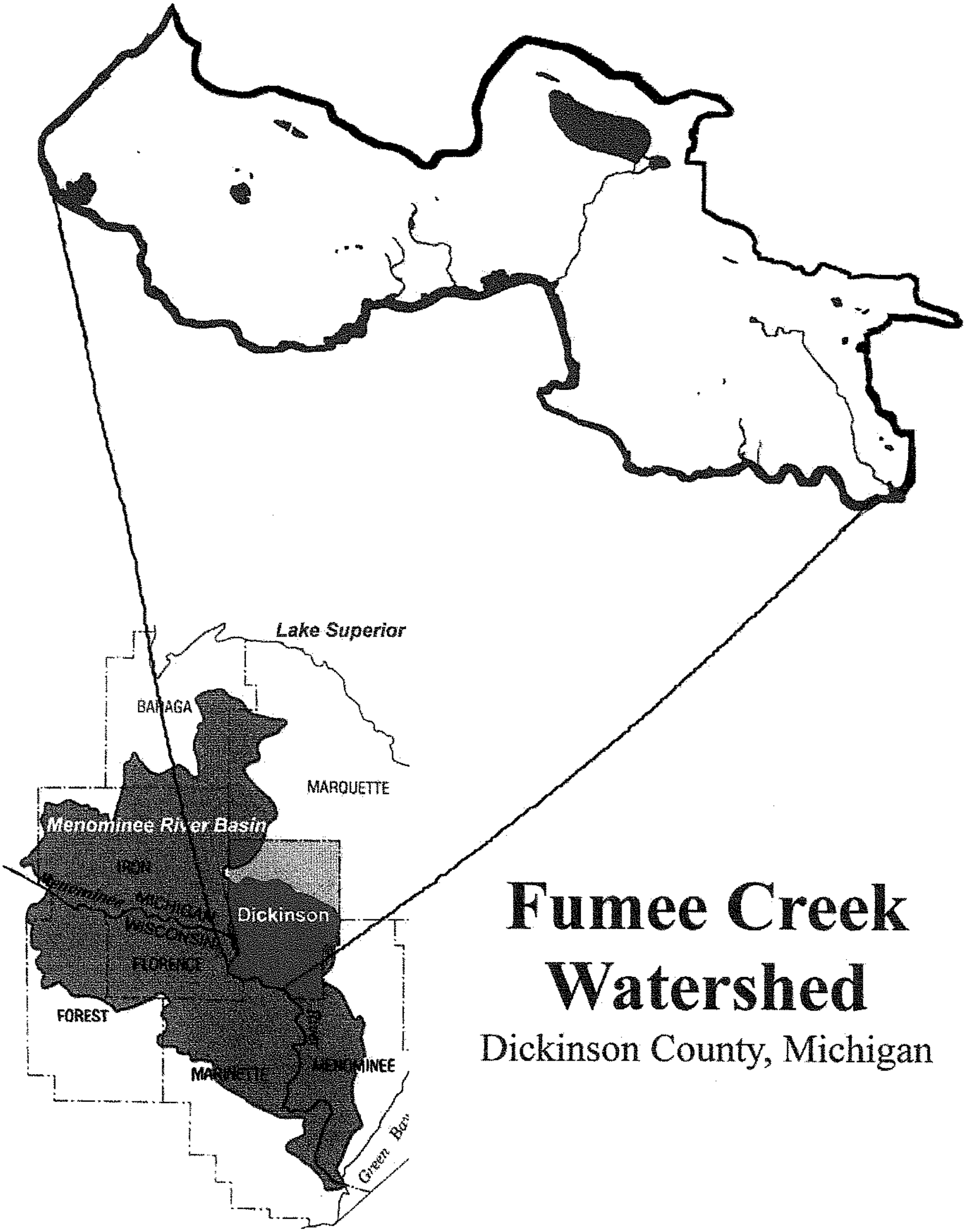


Fumee Creek Watershed

Dickinson County, Michigan

Introduction

The primary goal of the Fumee Creek Watershed Project and its Management Plan is to protect and improve surface water quality throughout the watershed. Raising public awareness and addressing resource concerns relating to the impacts of non-point source pollutants on surface water quality are the principal methods for achieving this goal. The Fumee Creek Watershed Project was initiated by the Dickinson Conservation District in an application for funding through Section 319 of the Federal Clean Water Act. These are EPA funds administered by the Michigan Department of Environmental Quality for the purpose of creating a Watershed Management Plan. The Dickinson Conservation District was awarded this grant funding in 1999.

Impetus for this project initially came from a comprehensive Menominee River Basin Study compiled in 1992. This study sought to "identify resource problems and develop resource management systems that will reduce identified resource degradation and still sustain socioeconomic productivity." The study identified resource problems on a hydrologic unit basis and completed reports for several included counties. Sixty-four percent of Dickinson County lies within the greater Menominee River Basin. Five priority problem study areas were identified within Dickinson County. Three of the Fumee Creek Watershed's subwatersheds (White Creek, Pier's Gorge-A, Pier's Gorge-B) were included in the #1 Priority Problem Study Area. Another three subwatersheds (Fumee Creek, Quinnesec-A, and Quinnesec-B) were listed in the #2 Priority Problem Study Area.

The Fumee Creek Watershed contains the most urbanized portion of Dickinson County, including the cities of Iron Mountain, Kingsford, and Norway, plus the U.S. 2 corridor in BreitungTownship which has seen rapidly expanding development in the last decade. Both public input and data gathered through various inventory methods were used to describe the threats to water quality. The impacts of urban stormwater entering the water bodies, untreated and at erratic flow velocities, was recognized as the most significant cause for pollutants such as sediment entering waterbodies. The legacy of iron mining in the watershed has left a rather unique imprint on the landscape and water resources in the area. For example, Chapin, Strawberry, and Curry "lakes" in the watershed are actually flooded mineshafts. Mine water from two mines (Hamilton/Chapin Mine in Iron Mountain and Aragon Mine in Norway) continues to be mechanically pumped into natural water bodies today. Treatment of the urban stormwater, through development of a county wide conscensus of stormwater ordinances which prescribe detaining, retaining, and vegetatively filtering the urban stormwater were some of the most significant Best Management Practices suggested in the Management Plan that follows.

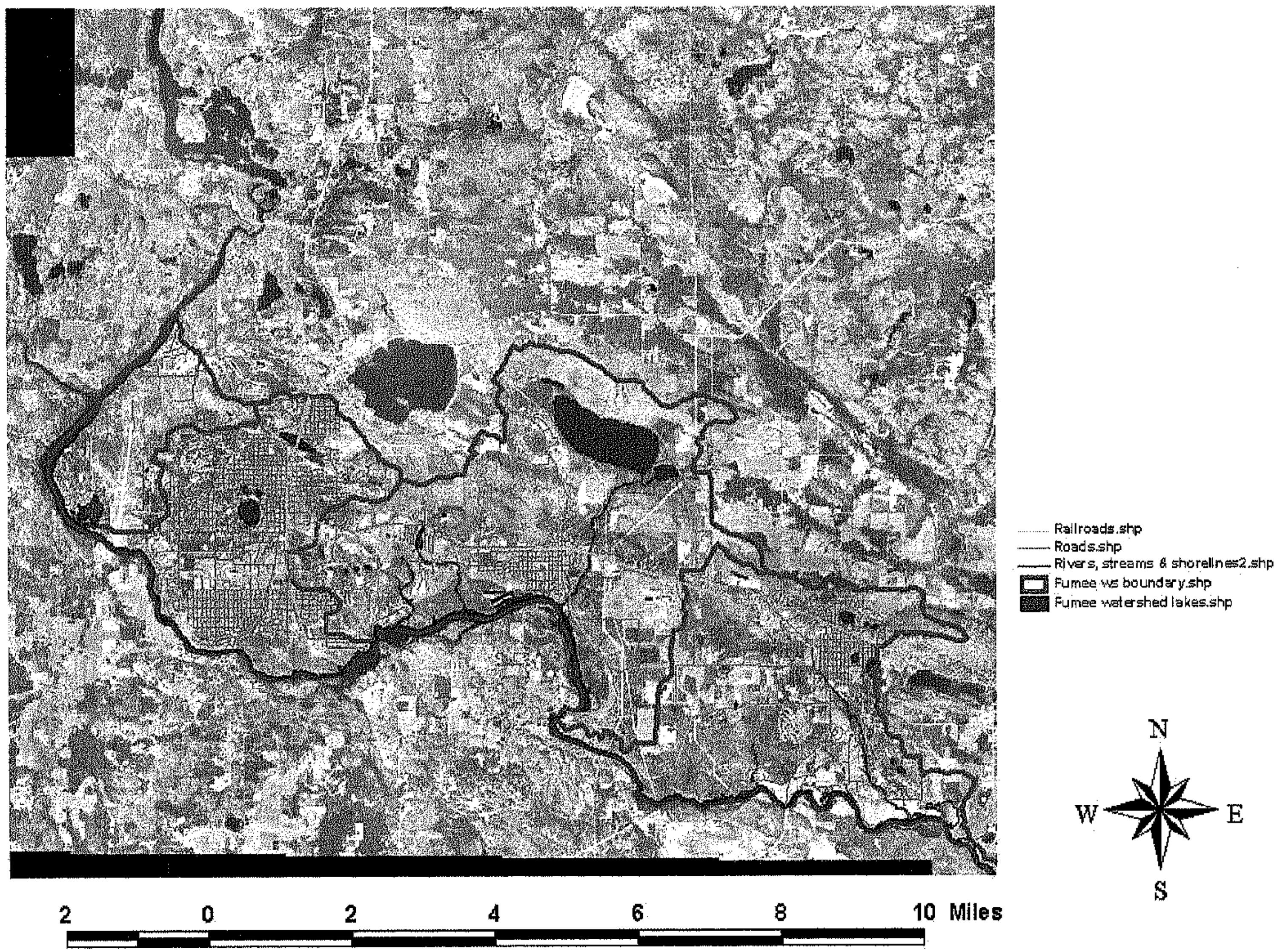
Acknowledgements

Sincere thanks go to all the public, private, corporate, governmental, educational, and service entities that contributed to the development of the Fumee Creek Watershed Management Plan. Funding from the Federal Environmental Protection Agency and oversight from the Michigan Department of Environmental Quality- Surface Water Quality Division laid the framework for it's purpose and content. The Board of Directors and staff at Dickinson Conservation District were the driving force behind its inception. The faithful advice of Watershed Council members set its priorities. Technical advice from the Natural Resource Conservation Service, Michigan Department of Environmental Quality, White Water Associates, Inc, Grand Valley State University, the Iron River Watershed Project and the Department of Natural Resources-Fisheries Division gave it credibility. And the multitude of volunteers and partners brought it to life in the public eye. A full list of watershed partners is listed below.

Fumee Creek Watershed Project Partners

Wisconsin Electric – WE Energies
Dickinson County Board of Commissioners
Dave Gillis – CUPPAD
City of Norway
Michigan Department of Natural Resources Fisheries
Bilski Enterprises
Quentin Peterson – Citizen
Danielson Greenhouse
Michigan Department of Environmental Quality
Michigan Department of Natural Resources - Wildlife
Breitung Township
Dickinson County Hospital System
Mountain Waste Water Treatment Plant
DickinsonConservation District
ShopKO
International Paper Co.
Pete Schlitt – Dick. Co. Emg. Preparedness
Dickinson Area Partnership
Kingsford High School
StoraEnso Paper Mill
WalMart
Danita Larson – Oak Hill Internet
Tim Klenow – U.P. Engineers & Architects
Trout Unlimited
Kevin & Lynn Anderson
Marvin & Marian Pollard
Lofholm's Building Supply
Les Johnson
Michigan Department of Transportation
Maple Leaf Kennel
Oak Crest Stables
Pine Grove Country Club
Norway/Vulcan Schools
City of Kingsford
City of Iron Mountain
USDA Farm Service Agency
Harry Kleiman – Well Driller
Dickinson County Road Commission
Dickinson County Health Department
K-Mart
International Paper Co.
Natural Resources Conservation Service
Dickinson County Solid Waste Management Iron
Jim Pawlowicz – Michigan Department of Agriculture
Fumee Lake Commission
Bob's Homes
Norway Township
Randy Wilkinson – U.P. RC&D
Kingsford Waste Water Treatment
UPTRA
Richard Rahoi – Dick. Co. Drain Commissioner
Nelson Paint Co.
Norway Waste Water Treatment Plant
Breitung Twp. Schools
Frank & Virginia Irish
Donald & Roxanne Anderson
Richard Gauthier
Wally's Auto Salvage
Holy Spirit School
Robert Gunville
John Daegner
Dickinson County Fair Board

Aerial Photo View of the Fumee Creek Watershed



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Fumee Creek Watershed Background Information

Location & Size

The Fumee Creek Watershed Project covers approximately 24,500 acres of southwestern Dickinson County in Michigan's Upper Peninsula. This land area contains the majority of the County's three primary urban areas in the cities of Iron Mountain, Kingsford, and Norway. The watershed also contains the village of Quinnesec, a small part of Norway Township, and nearly half of Breitung Township (Figure 1-Aerial photo).

The Fumee Creek Watershed is comprised of nine subwatersheds that discharges water by either stream flow or surface runoff to the Menominee River which bounds the Fumee Creek Watershed to the south and west.

Figure 2. Hydrologic Unit Codes/Areas For Subwatersheds Considered in Fumee Creek Watershed Project

Hydrologic Unit	Subunit	Subwatershed Name	Acreage
04030108- 060-	01 (A)	Ford Dam	2,284
	01(B)	Ford Dam	827
	02	Crystal Lake	4,091
	03 (A)	Quinnesec	509
	03 (B)	Quinnesec	3,430
	04	Fumee Creek	4,980
	05 (A)	Pier's Gorge	1,650
	05 (B)	Pier's Gorge	2,018
	06	White Creek	4,596

Source: Menominee River Basin Study, 1992

*** Future references to subwatersheds will refer to Ford Dam (A) and Ford Dam (B) as Ford Dam; Crystal Lake will remain Crystal Lake; Quinnesec (A) and Quinnesec (B) will be referred to as Poor Farm Creek; Fumee Creek stands as Fumee Creek; and Pier's Gorge (A) , Pier's Gorge (B), and White Creek will be called White Creek subwatershed.**

Waterbodies

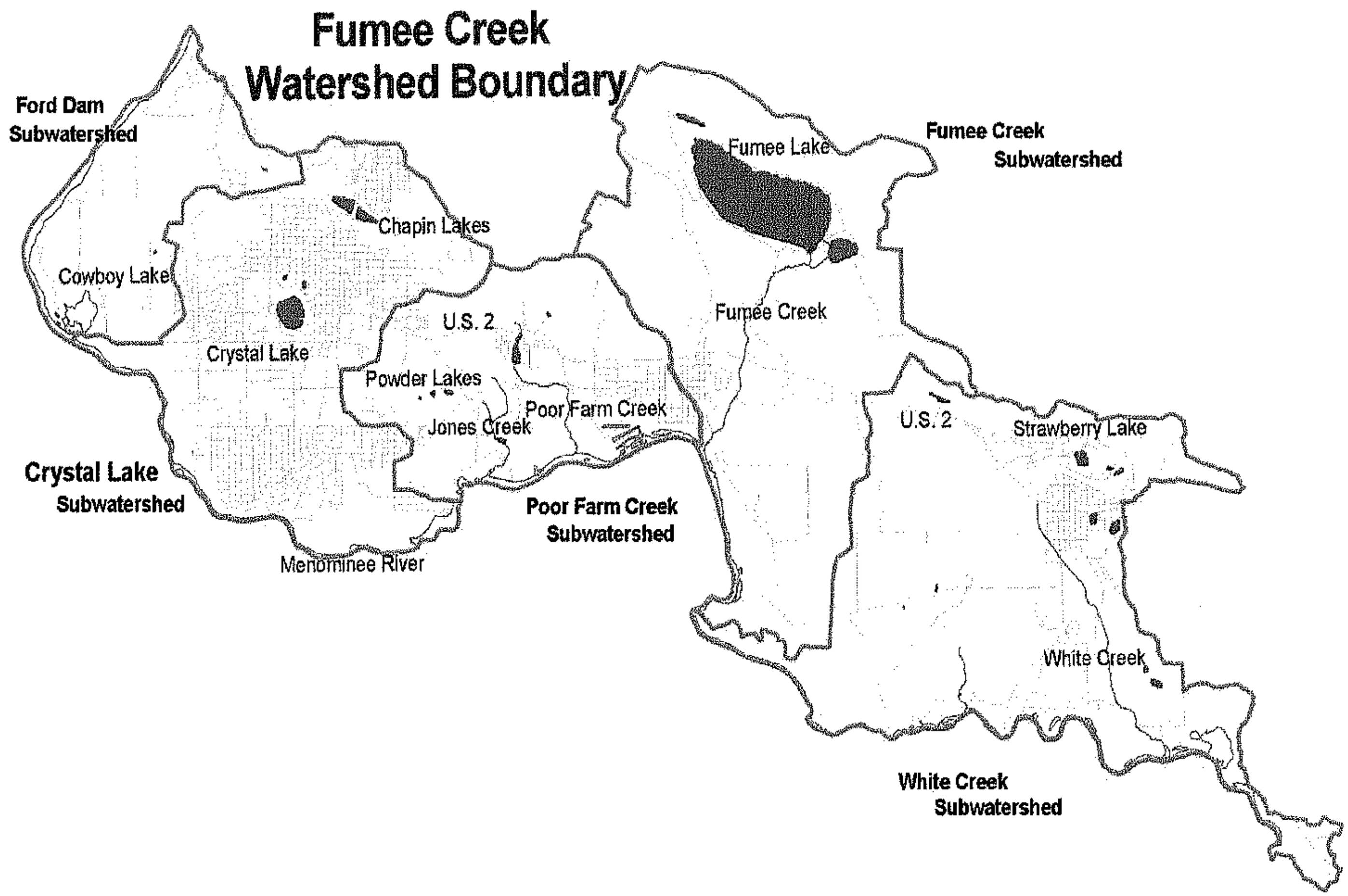
Nearly 20 miles of the **Menominee River** flows along the western and southern edge making the Menominee the most significant body of water in the Fumee Creek Watershed. Within the watershed, six main tributaries flow a combined length of over ten miles and discharge into the Menominee River. Creeks included in the Fumee Creek Watershed Project are: **Fumee Creek** (12,000 ft long), **White Creek** (23,000 ft long), **Jones Creek** (7,500 ft long), **Poor Farm Creek** (6,500 ft long), **Unnamed Creek feeding Crystal Lake** (2,000 ft long), and an **Unnamed Creek feeding Pier's Gorge** (2,000 ft long). Three of the creeks (Jones, Poor Farm, and Fumee Creeks) are rated as second quality trout feeder streams in the Menominee River Basin Study. The Menominee River is rated as a second quality warm water main stream for it's length in this study. White Creek was rated a second quality warm water main stream. *The creeks of the watershed are characteristically low in gradient, having a slope gradient less than 2 percent.* Only Fumee Creek experiences a significant gradient, as evidenced by its 40' vertical drop over Fumee Falls about .75 miles upstream of where it empties into the Menominee River.

Several natural lakes and ponds are also located in the Fumee Creek Watershed. The largest lakes include **Fumee Lake, Forest Lake (also known as Little Fumee Lake),** and **Crystal Lake**. Fumee and Forest Lakes are considered in greater detail in the **Special Resources Section**, of this chapter. Crystal Lake has been heavily impacted by mine water and recent stromwater additions and is further described in the mining impacts section that follows. According to MDEQ SWQD August 2000 Section 305(b) Report on Water Quality and Pollution Control in Michigan, ten of Dickinson County's significant lakes are classified as mesotrophic and the remaining two are considered eutrophic. None of the lakes in the Fumee Creek Watershed were classified in this report. However, a limnological survey conducted in 1994 determined **Fumee and Forest Lakes** to fall in the mesotrophic range using the Trophic State Index. About 25 acres of surface water are housed in several small natural or man-made ponds, which include **Dawn's Lake, Jones Pond, Mud Lake, Rocconi's Pond** and four un-named ponds.

Three hydroelectric dams on the **Menominee River, Little Quinnesec Falls, Big Quinnesec Falls, and Ford Dam** all form large area **impoundments** that are important recreation areas in the county. These impoundments contribute nearly 1000 acres of surface water within the watershed. **Cowboy Lake**, adjacent to the Ford Dam impoundment, and directly connected to the Menominee River, is a heavily used conduit for fishing and boating on the river. A city park with beach, picnic areas, and boat launch, as well as a restaurant, and twelve residences also impact Cowboy Lake.

Flooded/collapsed iron ore pit mines have created several surface water bodies that have significant impacts on the watershed due to their connections to ground water and pumping of the mine water creating artificial hydrological flow fluctuations in downstream waterbodies. These waterbodies include the **East and West Chapin (Pits) Lakes** in Iron Mountain, the **Curry Lakes** (East and West Lake Views) in Norway, and **Indiana Mine Pit** in Quinnesec, and **Strawberry Lake** in Norway.

Figure 3: Waterbody Locations in Fumee Creek Watershed



The following figure summarizes the waterbodies in the Fumee Creek Watershed:

Figure 4. Summary of Water Bodies in Fumee Creek Watershed

Subwatershed	Waterbody	Size**	Rating*	Location
Ford Dam-A	Ford Dam Impoundment	561 AC	E	T39 N R 31 W Sec 27, 34
	Cowboy Lake	34 AC		T39N R31 W Sec 34
	Menominee River	19,500 ft		T 39 N R 31 W
Ford Dam-B	Menominee River	15,500 ft		T 39 N R 31W 34, 27
Crystal Lake	Crystal Lake	37 AC		T 39N R 31W Sec 36
	Chapin Lakes (Pits)	20 AC		T39 N R 30W Sec 25, 30
	Mud Lake	2 AC		T 39 N R 31 W Sec 36
	Old Sewer Creek	10,500 ft	NR	T38 N R 31 W Sec 1, 12
Quinnesec-A	Big Quinnesec Falls Impoundment	257 AC		T 38 N R 31 W Sec 7,8
	Menominee River	12,000 ft	E	T38N R31W Sec3,11,12,7
Quinnesec-B	Dawn's Lake	4 AC		T 38N R 30W Sec 5
	Front Whitebirch Pond	2 AC		T 39 N R30 W Sec 32
	Forgette'sRiverside Pds	4 AC		T 38N R30 W Sec 3,4
	Jones Pond	2 AC		T38N R30W Sec 5
	Powder Lakes	4 AC		T 38N R 30W Sec 5
	Un-named Pond	1 AC		
	Menominee River	14,500 ft	E	T38N R30W Sec 7, 8
	Jones Creek	7,500 ft	D	T 38N R 30W Sec 5, 8
	Poor Farm Creek	9,000 ft	D	T 38N R30W Sec 4
Fumee Creek	Fumee Lake	478 AC		T39N R 30 W Sec 25-27, 35, 36
	Forest (Little Fumee) Lk	26 AC		T39 N R30W Sec 36
	Indiana Mine Pit	5 AC		T39N R 30W Sec 27
	Fumee Creek	12,000 ft	D	T39N R30W Sec 36,35, T38 N R30 W Sec 2
Pier's Gorge-A	Little Quinnesec Falls Impoundment	171 AC		T38N R30W Sec 10,11
	Menominee River	10,000 ft	E	T38N R30W Sec 8,9,10,11
Pier's Gorge-B	Un-named Pond	3 AC		T38N R 29 W Sec 6
	Rocconi's Pond	2 AC		T38N R29W Sec 19
	Menominee River	32,500 ft		T38N R30W Sec 23,24
	Un-named Stream	2,000 ft		T38N R29W Sec 19
White Creek	Strawberry Lake	7 AC		T38N R 29W Sec 8,9
	East Curry Lake	1 AC		T38N R29W Sec 9
	West Curry	2 AC		T38N R29W Sec 9
	East Lake View	4AC		T38N R29W Sec 9
	West " ", Lk. Mary	5AC		T38N R29W Sec 9
	Mud Lake	3 AC		T38N R29W Sec 21
	Un-named Pond	2 AC		T38N R29W Sec 16
	Un-named Pond	1 AC		T38N R 29W Sec 8
	White Creek	23,000 ft	G	T38N R29W Sec 8,16,21

- Stream Quality Ratings adopted froom the Menominee River Basin Study, 1992.

D- Second Quality Trout Feeder Stream E- Top Quality Warm Water Main Stream
G- Second Quality Warm Water Main Stream
** All numbers are approximate measurements taken from USGS topo maps and aerial photos.

Mining Impacts In The Watershed

The mining history in Dickinson County has created many unique and quite unnatural alterations to the groundwater and surface water resources in the Fumee Creek Watershed. Seven lakes in the watershed are a result of mining depressions filling with water after the mine was closed and groundwater pumping ceased. Two such situations are of particular interest to surface water quality and projects included in this management plan. The Chapin Mine in Iron Mountain (T40N, R30W, Sec.30 SW ¼, SW ¼ and T40N, R31W, Sec. 25, SE ¼, SE ¼) was the second largest ore producer in the Michigan Upper Peninsula. During peak operation of the mine the Cornish Pump, the largest of its kind in the United States, discharged up to 4 million gallons of water a day from the various mine shafts. U.S. Highway 2 crosses the mine depression and splits into an east and west half that are now referred to as the **Chapin (Pits) Lakes**.

While the mine was operating, the Cornish Pump discharged water to **Crystal Lake** located in the middle of the city. Crystal Lake probably received its name because of the clear, high quality groundwater constantly being supplied to it. At that time, a small stream on the eastern shoreline at approximately "H" Street, served as the outlet to Crystal Lake and flowed south to the present location of the Iron Mountain/Kingsford Waste Water Treatment Plant on the Menominee River. The Chapin Mine water source increased the efficiency of this small creek to convey raw sewage from Iron Mountain to the Menominee and gave the creek its local name of Sewer Creek. The old Sewer Creek is now blocked off as an outlet to Crystal Lake and has mostly been filled in. The Sewer Creek right-of-way is still maintained and contains underground piping that is partially utilized as sanitary sewer lines for Iron Mountain and Kingsford. Crystal Lake no longer receives pumped groundwater from the Chapin Mine. It does however receive a very large portion of stormwater from Iron Mountain through a 96-inch discharge pipe near "H" Street. This stormwater input is in addition to historically smaller inputs and was a result of a 1996 storm sewer separation project conducted by the City. Crystal Lake has been described as being a perched lake that is disconnected from the groundwater table and loses water through fissures in the bottom. Large stormwater contributions to the lake have created flooding problems on streets and in homes around the lake. In the summer of 2001, the City of Iron Mountain altered the storm sewer network so that the City has the ability to discharge excess stormwater flows to the East Chapin Lake and greatly reduce the chance of Crystal Lake levels rising too high and flooding area residents.

When the Chapin Mine ceased operations, the 2,300-foot deep **Hamilton Mine Shaft** located just north of the West Chapin Lake, and the mining tunnel connected Chapin Lakes, saw water levels rise high enough to cause flooding of basements and storm drains in the northeast section of town. Many parts of the city were most likely settled during the operation of the mine and without anticipating the recharge of natural groundwater levels if the mine stopped its pumps. In 1925, the City of Iron Mountain reacted to the situation by installing a pump 90 feet below the surface of the Hamilton Mine Shaft and pump this water to feed the newly installed water filtration plant. The piped Hamilton Mine Shaft water and the filtration plant served as the Iron Mountain public drinking water supply until the late 1960's.

Although the water filtration plant is no longer in service, the water being pumped from the Hamilton Mine Shaft continues to flow to **Lake Antoine**. Local officials have stated that maintaining the Hamilton Mine Shaft discharge continues to be necessary to prevent basement flooding on the north and west sides of Iron Mountain, to maintain a constant water level in Lake Antoine, and to prevent the large, shallow lake from drying up. A Baseline Limnological Study of Lake Antoine performed by White Water Associates, Inc. was completed in 2000 and states that the lake has a volume of 1.3 billion gallons. The study reports calculations performed on data from local officials that water is being pumped from the Chapin Pit at an average of 12 hours per day. This rate of pumping equals an estimated discharge of 1.5 million gallons a day and over 540 gallons of water a year. At this rate of discharge, the entire volume of Lake Antoine is replaced every three years.

Many people believe that additions of storm water have led to an increase in weed growth and an overall decrease in water quality. Area citizens also believe that there have been significant declines in wildlife species and usage. Additionally, a large concern in

Dickinson County is to maintain the high quality of Lake Antoine. There is a connection from the East and West Chapin Lakes to the Hamilton Mine Shaft through old mining tunnels and groundwater seepage. There is a real possibility that discharging more stormwater to the Chapin Lake could degrade the quality of Lake Antoine because of the pump connection between Lake Antoine and the Hamilton Mine Shaft.

Past mining activity created another similar situation in the City of Norway where there is an unusual connection between groundwater and surface water. Four of the lakes in the **White Creek** subwatershed were created as a result of mining. Three of these lakes are now connected in an unconventional way to White Creek. **Strawberry Lake,** which is nearly 100 feet deep, is the result of the Aragon iron ore mine that operated from 1889-1929 and the two **Curry Lakes** are located in depressions left behind after the Curry Mine activity from 1879-1892. These mines operated a system of sumps and pumps to remove groundwater that entered the mineshafts and working areas while the mines were in operation. Once again, when these mines ceased operation and stopped pumping groundwater from the underground network of tunnels and shafts, the groundwater table rose, filled the depressions, and eventually flooded several low lying areas on the southwest side of the City.

The City of Norway remedied the situation by installing a pump in the Aragon Mine Shaft to pump groundwater from the mines. Two pumps continue operation today and the City states in the 2001 Comprehensive Plan that this "pumping controls the area's water table protecting against basement flooding while increasing the flow volume of White Creek that benefits wastewater treatment operations downstream". The Aragon Shaft is located directly west of Strawberry Lake and north of where the White Creek channel takes a 90 degree turn near U.S. Highway 2 and flows south toward the Menominee. Water pumped from the Aragon Shaft discharges at the 90-degree turn just south of U.S. 2 through the center culvert and mixes with stormwater from a small commercial drainage area north of the creek. Currently only one of the pumps operate at one time while the other is an emergency back up to be used during times of high water or primary pump failure. Each pump is capable of discharging approximately 2,500 gallons/minute to White Creek.

White Creek's headwaters begin at a spring fed pond and continue to flow east through mixed forests and cedar swamp land. Prior to 1900 approximately 1 3/8 miles of the channel was straightened up to the present location of the **Norway Wastewater Treatment Plant**. There is evidence that the channel was straightened further downstream of the treatment plant but the channel closely resembles a more natural pattern of flow. Through a brief understanding of the mining history described above and several personal communication reports, there are most likely two reasons this creek was channelized. First, the City of Norway piped its raw sewage to this creek and used the flow to carry the sewage to the Menominee River. Secondly, the mines had to discharge the pumped ground water to a place where it would dissipate and not create any problems for the developing community. The east to west flowing portion of the creek was most likely straightened to meet both the mine pump discharge and the main sewer pipes entering the creek. Directing the flow to the 90-degree bend location would augment the flow and increase the overall velocity by decreasing the channel length and increasing the creek gradient. From that location, the channelization of White Creek continued south to increase flow efficiency up to an area further south of town where it was less likely to be a threat to public safety. A secondary resultant of channelizing White Creek on the east to west flowing section enabled individuals to drain the muck soils present and increase the ability to attempt farming operations on this land.

Climate & Precipitation

The climate in Dickinson County is northern continental and lies in an area in the Upper Peninsula that does not receive direct affects on the weather patterns from either Lake Superior or Lake Michigan. The prevailing winds and weather patterns come from the southwest during the warmer months and from the northwest during the cold months. Therefore, the County does not receive Lake Affect snow and also does not receive the temperature moderating affect from the lakes that reduces temperature fluctuations. Instead, the area tends to experience temperature extremes with long, cold winters and short, warm summers.

The average winter temperature in Iron Mountain is 16.3 degrees F with and average daily minimum of 6.5 degrees F. Iron Mountain's average summer temperature is 64.9 degrees F and the average daily maximum is 77.3 degrees. Temperature extremes for the Fumee Creek Watershed area range from -39 degrees F to 104 degrees.

Total annual precipitation for Iron Mountain is 29.84 inches (Figure 5). On average, 20.1 inches (67.4 percent of the yearly total) of precipitation falls between the months of April and September and coincides with the growing season of most crops. Thunderstorms occur on about 30 days each year, and most occur during June and July. Rainfall frequencies for 24-hour duration 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year storm events produce 2.39 inches, 3.00 inches, 3.48 inches, 4.17 inches, 4.73 inches, and 5.32 inches of rain respectively. (During June and July the area experiences the highest occurrence of thunderstorms totaling around 30 days each year).

The majority of the snowfall in Dickinson County occurs from November to March. During this period, 58.2 inches of the 63.3 inch yearly total snowfall occurs (Figure 5). On average, Iron Mountain sees 116 days of the year that have one inch of snow on the ground but that number can vary greatly from year to year.

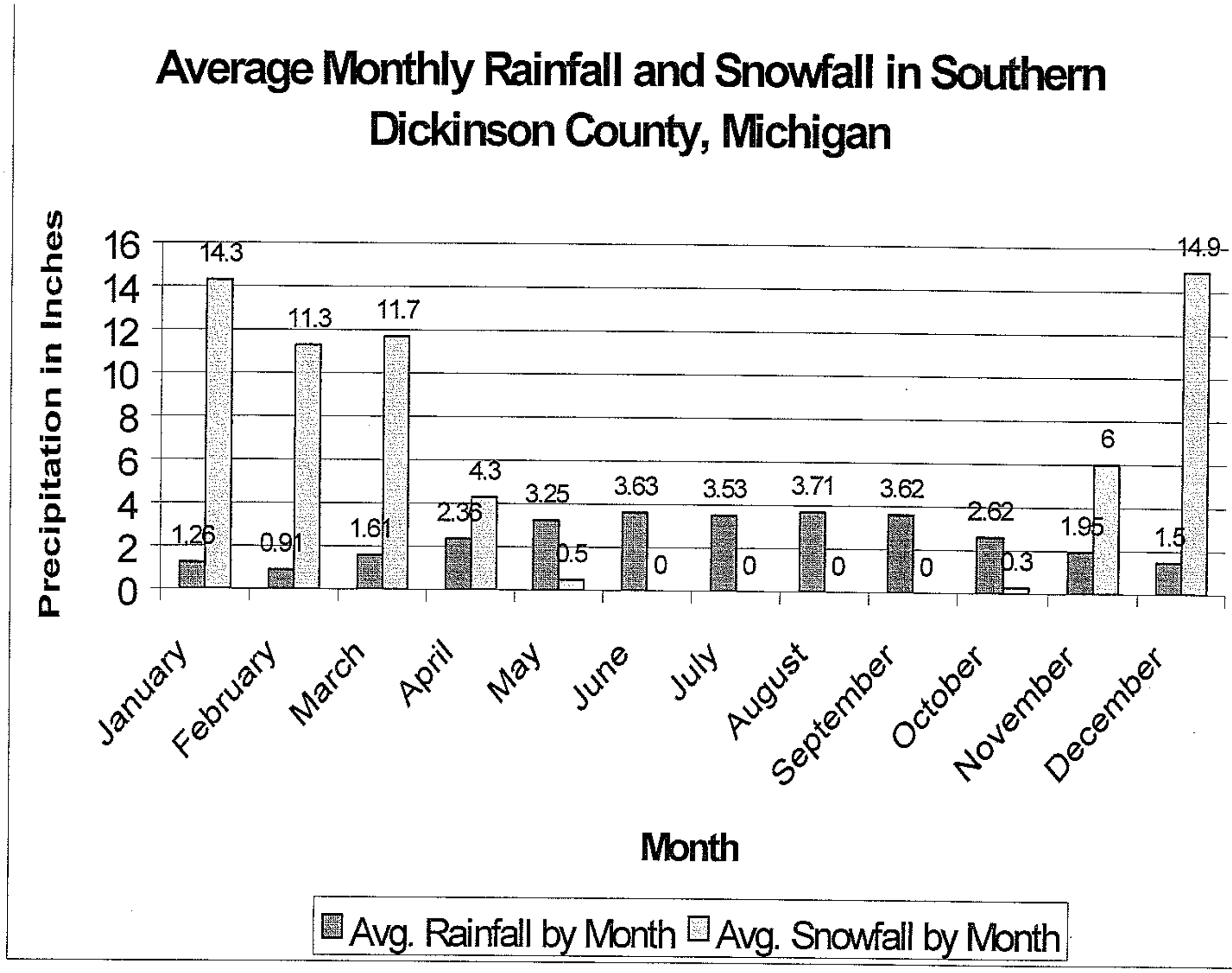


Figure 5. Average Monthly Rainfall and Snowfall in Southern Dickinson Co., MI

Sources of Information include: Dickinson County Soil Survey and field data records from the Iron Mountain-Kingsford Wastewater Treatment Plant

Total average annual rainfall for Dickinson County = 29.84 inches.
Total average annual snowfall for Dickinson County = 63.3 inches.
Rainfall data was collected at the Iron Mountain-Kingsford Wastewater Treatment Plant from 1958 to 2002.
Snowfall data were taken from the Dickinson County Soil Survey. Totals reflect data collected from 1952 - 1980 in Iron Mountain, MI

Geology and Topography

Dickinson County is part of a high plateau region. Elevation ranges from about 800 to 1,600 feet above sea level. The physiography of the county is the result of continental glaciation, modified in some areas by bedrock. The dominant features are moraines, till plains, and outwash plains. Glacial drift in the area is composed of mixtures of sand and gravel, silt, clay, cobbles, and, boulders. Bedrock in the county includes dense igneous, sedimentary, and metamorphic rocks of Precambrian age and sandstones and dolomites of Cambrian and Ordovician age.

Much of the topography of the southwestern part of the county is bedrock controlled. The Menominee Range, in the vicinity of Iron Mountain and Vulcan, is a high ridge of bedrock covered with a thin layer of glacial till. Other bedrock-controlled areas are in a complex system of low ridges and knobs, which generally are covered with till but which have many small rock outcrops. Intermixed with these bedrock-dominated areas are moraines, till plains, and outwash plains. The largest outwash area is in the southwest corner of the county, near the Menominee and Sturgeon Rivers.

Soils

The types of soils found on the earth's surface can be highly variable from place to place. Parent material, climate, biotic factors, topography, and time are the five soil forming factors that develop a soil from non soil parent material and organic matter. **Parent material** is the original source of material that is exposed to weathering and can be made up of various rock types or transported to a location by wind, water, glaciers, and gravity. **Climate** is dependent on the temperature, rainfall, elevation, and latitude of the area and influences the rate of weathering and the type of plant and animal life present in the region. **Biotic factors** such as vegetation, animals, bacteria, and fungi are responsible for the nutrient content of the soil through the addition and breakdown of organic matter. **Topography** influences the rate of erosion and deposition by determining the amount of water that either soaks into the soil or runs of the soil surface. **Time** governs the period in which the weathering of rock material occurs and determines the stage of soil profile development as a result of the other soil forming factors.

Four soil textures, loamy sands, loamy fine sands, very fine sands, and fine sandy loams, comprise over 75% of the Fumee Creek Watershed land area (Appendix A). Pemene fine sandy loam, Emmet fine sandy loam, Pence fine sandy loam, Oconto fine sandy loam, Vilas loamy sand, Channing fine sandy loam, Zimmerman fine sand, and Emmet-Pemene fine sandy loams are the primary soil series found in the four main soil textures. Other important soils include Waucedah-Cathro complex, Carbondale and Cathro mucks, and Rubicon sands.

The quality and quantity of runoff generated in a watershed has a direct impact on the water quality of lakes and streams. The ability and rate that soils allow precipitation to soak into the ground and percolate down through the soil column has a direct impact on the amount of runoff that occurs in an area. Soils have been divided into four categories based on their infiltration rates, drainage, and water holding capacities. These categories are referred to as hydrologic soil groups. (and play a role in determining what land uses are suitable for each soil type.) Hydrologic soil groups area used to estimate runoff from precipitation. Non-vegetated soils are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long- duration storms. The four hydrologic soil groups are described as follows.

- **Group A.** Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- **Group B.** Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderated rate of water transmission.
- **Group C.** Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

- **Group D.** Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Nearly all of the soil types in the Fumee Creek Watershed area are hydrologic group A and B soils. The exception is hydric soils that are typically water saturated wetland soils. These soils are classified as hydrologic group D because they are unable to accept much water into the soil column and produce more runoff. A vegetative cover of increases the ability of soils to transmit water, dewater the soil when wet, reduces the velocity of runoff, and reduces the amount soil eroded from the surface and deposited elsewhere.

Hydrologic group A and B soils in the watershed have historically allowed the majority of the fallen precipitation to infiltrate into the ground without producing large amounts of runoff. Thus, the surface water quality in the area has largely benefited by receiving cool, clean, and stable flows from groundwater inputs. Stream channels take shape based on these inputs and the soil material that the channel flows through. Eventually the stream finds a dynamic equilibrium where change occurs but on a slower more predicable basis.

Past and Present Land Use/Cover

Presettlement land cover in the Fumee Creek Watershed consisted of primarily coniferous forest, with Red Pine/White Pine, Hemlock/White Pine, and Jack Pine Forests being the most common associations in the central and eastern portions of the watershed. (See Appendix B). Much of the area that is now Iron Mountain and Kingsford was Aspen/Paper Birch forest, grading to Jack Pine in the poorer soils in what is now southern Kingsford (Skidmore area). The onset of logging and the discovery of iron ore in Waucedah (1866), resulting in the development of the Menominee Iron Range, had a rapid influence on the vegetation and land use in the area. Jobs in logging and mining industries attracted a massive migration of settlers to the area, enticing Cornish, Swedish, Finns, Norwegians, Italians, and Slavs. At one time the town of Quinnesec was the largest in the Upper Penninsula and home to approximately 50 pit mines as part of the the Menominee Iron Range. In 1879, one of the richest ore deposits in the world was discovered five miles west of Quinnesec, in what would become the boom town of Iron Mountain. The first railroad came to the area in 1877 and hastened the extraction of the forest resource. When electricity came on the scene in 1880, mines employed the technology to light and pump water out of mine shafts, enabling nearly 300 million tons of ore to be extracted. As mining waned, industrial land uses increased. In 1921, the Ford Motor Company built a large saw mill and automotive component plant (wooden bodies to capitalize on area timber resources) on 313,000 acres in Kingsford. By-products of the plant were used to make the well-known Kingsford Briquettes. By 1950, operations at the Ford plant ceased, but Kingsford still feels the effects of the Ford Plant, in the high incidence of trapped methane gases from buried wastes in its' soils and groundwater. A vigorus methane monitoring program was initiated in the 1990's and continues today.

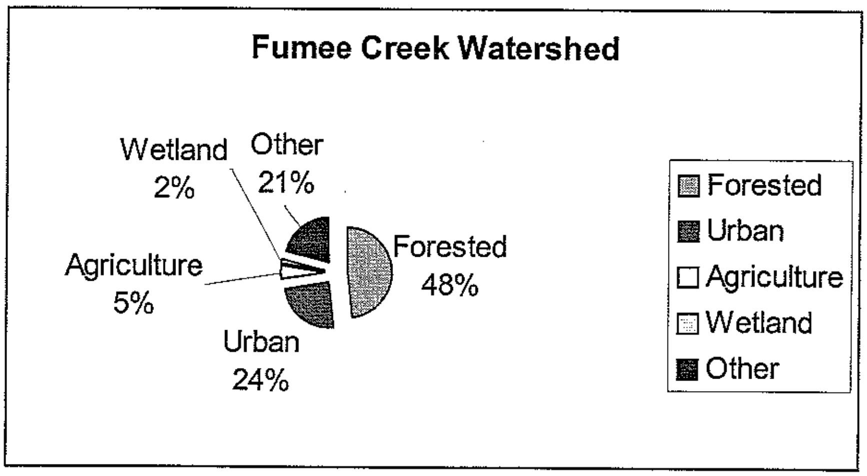


Figure 6. Fumee Creek Watershed Land Use, 1990.

Today, this watershed is the most urban and populated in Dickinson County. As of the 1994 Menominee River Basin Study, the watershed was 48% forested, 24% urban, 5% agricultural, 2% wetland, and 21% other land use categories. (See Appendix C). Industrial parks from Kingsford and Norway are currently located in the watershed. Some of the resource concerns that moved the six subwatersheds into top priorities in the Menominee River Basin Study included:

- Waste Treatment lagoons from two paper mills
- Waste treatment tanks from two paper mills
- Railroad tank car yards from two paper mills
- Chemical storage facilities for one paper mill and one company
- One golf course
- Chemical/Nutirent storage at one feed mill and three landscape/nursery businesses
- Norway and Iron Mountain/Kingsford Waste Water Treatment Plants
- Stormwater run-off from City of Norway
- Residential Septic Systems from approximately 800 homes
- Two auto salvage yards
- Two oil storage yards
- Four trucking company yards
- Residential fertilizer and pesticides
- Eleven gravel or sand mines
- County and township salt storage sheds
- Two hyrdoelectric dams
- One county landfill
- Dawn's Lake-large stormwater detention ponds

Since the Menominee River Basin Study, there has been a significant increase in commercial retail and residential development. In the past decade, the U.S. 2 corridor has seen the development of the Kmart Plaza, Wal-Mart, Home Depot, Dickinson Memorial Hospital, eleven fast food restaurants, and several gas stations with their accompanying runoff from a greater percentage of impervious surfaces. Additional subwatershed include the City of Iron and Kingsford, which are now drained primarily by separated storm sewers, but include ever increasing amounts of impervious surfaces.

The Michigan Upper Peninsula's reputation for high quality and wide reaching recreational opportunities has added some stability and growth to the area's population. The County has seen a growing market in recent years for year-round tourism and recreational industries. Logging and manufacturing continue to be strong points in the economy.

Unemployment rates have remained low in the past few years (5.0 – 6.0%) due to the presence of larger employers such as International Paper, Grede Foundries, Inc., Louisiana-Pacific Corporation, Khoury, Inc., Northstar Print Group, Lakeshore Inc., Systems Control, Foley-Martens, and Dickinson Homes. The economic stability in southern Dickinson County has produced steady overall population increases from 1970 to 2000 (USCB) The most pronounced population increases in and around the Fumee Creek Watershed is Breitung Township, which has doubled in size since 1940, while the Norway Township population has increased by 28.9 percent since 1940 (USCB) (See Appendix D) An updated land use map for the County/ watershed would be a sound objective for land use planning.

Special Resources

The **Fumee Lake Natural Area** was formed in 1992 when 80 percent of Dickinson County voters passed a bonding proposal or the acquisition of the area from the City of Norway. The City of Norway used Little Fumee Lake (also known as Forest Lake) as its public drinking water supply from 1910 to 1988, and as such, public access was prohibited in the areas adjoining the lakes. Now over 2000 acres in size, this Natural Area provides five miles of undeveloped shoreline around two lakes totaling 507 acres. Two hundred seventy species of plants, 137 species of birds, 7 species of fish, 26 species of mammals, 6 species of amphibians, and 6 species of reptiles have been identified in the Fumee Lake Natural Area. Just 5 miles from Dickinson County's most populated urban areas, the Natural Area provides residents and visitors an opportunity to enjoy educational and non-motorized recreational activities such as wildlife viewing, hiking, mountain biking, and cross country skiing.

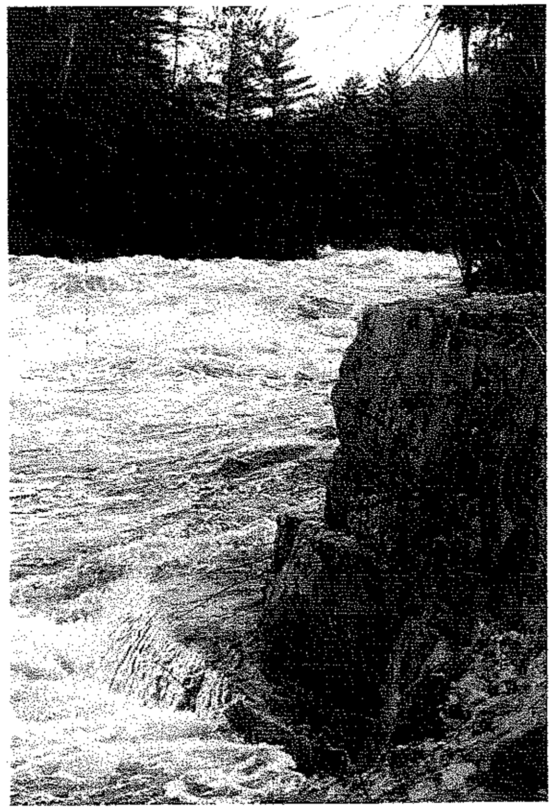
The **Pier's Gorge Recreation Area** is another unique natural resource in the Fumee Creek Watershed. Grade 3 rapids along the Pier's Gorge section of the Menominee River is recognized as one of the most challenging sections of whitewater in the Midwest. A 1-½ mile linear trail accesses several views of the river's cascades.

Fumee Falls is a popular tourist attraction in Dickinson County. Located on U.S. between Quinnesec and Norway, it is housed in an MDOT roadside park. Fumee Creek cascades 40-60 ft down a granitic outcrop in plain view of the road. The creek then rejoins its bed and flows under U.S. toward the Menominee River a few thousand feet downstream. Foot traffic up the side of the falls has unfortunately resulted in degradation and erosion of the slope next to the Falls.

Artesian Wells/Springs are two other natural features of interest in the watershed. The Norway Spring artesian well runs in a roadside park on U.S. 2 just west of the City of Norway. Many people visit the site to sample and bottle water to take home. At least two more artesian wells are located in the Fumee Lake Natural Area. A stone fountain has been developed for one near the west parking lot and is enjoyed by used by recreational users.

Special Features

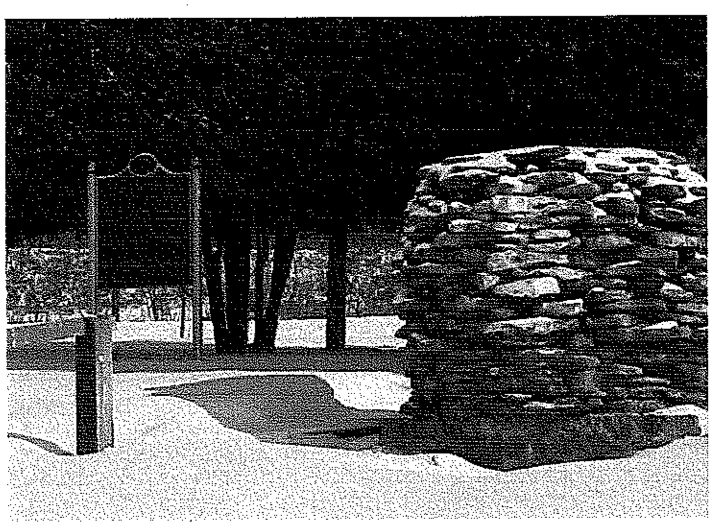
Fumee Falls



Pier's Gorge

Fumee Lake

Norway Spring



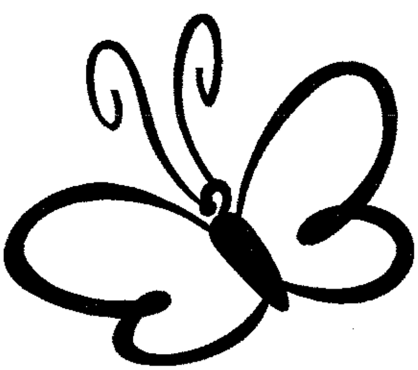


Figure 8: Michigan Natural Features Inventory special features in the Dickinson County area.

The Michigan Natural Features Inventory has compiled a list of elements that have recently and historically been found in Dickinson County. Elements included in the table below are state classified plants, invertebrate animals, vertebrate animals and unique geologic features and communities.

Vertebrate Animals

Common Name	Scientific Name	State Status
Wood Turtle	Clemmys insculpta	Special Concern
Common Loon	Gavia immer	Threatened
Bald Eagle	Haliaeetus leucocephalus	Threatened
Osprey	Pandion haliaetus	Special Concern
Black-backed woodpecker	Picoides arcticus	Special Concern

Invertebrate Animals

Freija fritillary	Boloria fritillary	Special Concern
Red-disked alpine	Erebia discoidalis	Special Concern
Rapids clubtail	Gomphus quadricolor	Special Concern
Northern blue	Lycaeides idas nabokovi	Threatened

Vascular Plants

Round-leaved orchis	Amerorchis rotundifolia	Endangered
Walking fern	Asplenium rhizophyllum	Threatened
Cooper's milk-vetch	Astragalus neglectus	Special Concern
Goblin moonwort	Botrychium mormo	Threatened
Assiniboia sedge	Carex tincta	Threatened
Sedge	Carex tincta	Special Concern
Purple clematis	Clematis occidentalis	Special Concern
Slender cliff-brake	Cryptogramma stelleri	Special Concern
Laurentian fragile fern	Cystopteris laurentiana	Special Concern
Fragrant cliff woodfern	Dryopteris fragrans	Special Concern
Purple cliff-brake	Pellaea atropurpurea	Threatened
Slender beard-tongue	Penstemon gracilis	Endangered
Pine-drops	Pterospora andromedea	Threatened
Blunt-lobed woodsia	Woodsia obtusa	Threatened

Community

Bedrock glade	Upper Midwest type glade

Geologic Features

- Early precambrian earth history (Bluffs)
- Gorge (Pier's Gorge)
- Middle precambrian earth history
- Unconformity

II
Designated Uses of Waterbodies in Fumee Creek Watershed

The State of Michigan's Law describes under the Part 4, Rules of the Water Resources Protection , Part 31 of Public Act 451, of 1994, that water quality standards shall be met in all waters of the state. In addition, the rules require that all designated uses of the receiving waterbody be protected. The following are brief descriptions of the eight Michigan Designated Uses described in the Water Resources Protection Part 31 of Public Act 451 of 1994. A coldwater fishery is an additional designated use for specific waters classified by the State as capable of supporting coldwater species.

1) **Agriculture** – "A use of water for agricultural purposes, including livestock watering, irrigation, and crop spraying."

2) **Industrial water supply** – "A water source intended for use in the commercial or industrial applications or for noncontact food processing."

3) **Navigation** – "Waters where the ability exists to navigate commercial and recreational watercraft." (This is a personal interpretation because a specific definition was not found in Michigan Department of Environmental Quality documents)

4) **Public water supply at the point of intake** – "A surface raw water source that, after conventional treatment, provides a source of safe water for various uses, including human consumption, food processing, cooking, and as a liquid ingredient in foods and beverages."

5) **Warmwater fishery** – "A waterbody that contains fish species that thrive in relatively warm water, including any of the following: Bass, Pike, Walleye, and Panfish."
   - Dissolved oxygen for waters protected as a warmwater fishery shall not be lowered below a minimum of 4 mg/l, or below 5 mg/l as a daily average, at the design flow

during the warm weather season. At design flow during other seasonal periods, a minimum dissolved oxygen standard of 5 mg/l shall be maintained.

6) **Other indigenous aquatic life and wildlife** – "The use if the surface waters of the state by fish, other aquatic life, and wildlife for any life history stage or a activity and the production of fish for human consumption."
   - Dissolved oxygen for waters protected as a warmwater fishery shall not be lowered below a minimum of 4 mg/l, or below 5 mg/l as a daily average, at the design flow during the warm weather season. At design flow during other seasonal periods, a minimum dissolved oxygen standard of 5 mg/l shall be maintained. Waters protected for indigenous aquatic life and wildlife must meet a minimum dissolved oxygen standard of 4 mg/l during the warm weather season and 5 mg/l during other seasons.

7) **Partial body contact recreation** – "Any activities normally involving direct contact of some part of the body with the water, but not normally involving immersion of the head or ingesting water, including fishing, hunting, and dry boating."

8) **Total body contact recreation between May 1 and October 31** – "Any activities normally involving direct contact with water to the point of submergence, particularly immersion of the head, with considerable risk of ingesting water including swimming."

9) **Coldwater fishery** – "A coldwater fishery means waterbodies that contain fish species which thrive in relatively cold water, including any of the following: Trout, Salmon, Whitefish, Cisco."
   - Dissolved oxygen for waters protected as a coldwater fishery shall not be lowered below a minimum of 6 mg/l at the design flow during the warm weather season and shall not be lowered below 7 mg/l during other seasonal periods.

During initial meetings of the Watershed Advisory Council, a number of resource concerns were identified. These were matched with the designated uses that might be impaired.

Figure 9. Fumee Creek Watershed Water Quality Concerns and Affected Designated Uses

Watershed Concern	Affected Waterbodies	Threatened Designated Use
Algae Blooms	Cowboy Lake	Partial & Total Body Contact - Recreation
	Dawn's Lake	Warmwater fishery
Lack of Stormwater	White Creek	Partial & Total Body Contact - Recreation
Detention/Sediment Basins	Poor Farm Creek Crystal Lake Fumee Creek Chapin Lakes (Pits)	Warmwater fishery Coldwater fishery Aquatic Life/Wildlife
Combined Sewer Overflow	Menominee River	Partial & Total Body Contact - Recreation
Discharges & Residential Sewer Backups	White Creek	Warmwater fishery Coldwater fishery Aquatic Life/Wildlife
Direct Stormwater Discharges	Crystal Lake	Partial & Total Body Contact - Recreation
	White Creek Poor Farm Creek Chapin Lakes (Pits)	Warmwater fishery Aquatic Life/Wildlife
Excessive Plan Growth	Cowboy Lake Menominee River	Navigation Partial & Total Body Contact - Recreation Warmwater fishery Aquatic Life/Wildlife
Exotic Species	Cowboy Lake	Navigation Partial & Total Body Contact - Recreation
Erosion from Construction Sites	All waterbodies	Warmwater Fishery Coldwater Fishery Aquatic Life/Wildlife
Eroding Road - Stream Crossing	Fumee Creek White Creek Poor Farm Creek Pier's Gorge Creek	Warmwater Fishery Coldwater Fisher Aquatic Life/Wildlife
Litter and Debris	White Creek Crystal Lake Chapin Lakes (Pits)	Aquatic Life/Wildlife

Flooding & Hydrologic Flow Extremes	Crystal Lake White Creek Menominee River Fumee Creek (future)	Warmwater Fishery Coldwater Fishery Aquatic Life/Wildlife
Nutrient Loading	Cowboy Lake	Partial & Total Body Contact - Recreation
Stormwater & Residential	Crystal Lake White Creek Poor Farm Creek Chapin Lakes (Pits)	Warmwater Fishery Coldwater Fishery Aquatic Life/Wildlife Navigation
Eroding Recreation Trails	Fumee Creek White Creek	Warmwater Fishery Coldwater Fishery Aquatic Life/Wildlife
Eroding Streambanks	White Creek Poor Farm Creek	Warmwater Fishery Aqutic Life/Wildlife

Will the water in Fumee Creek Watershed meet designated uses now and in the future?

Threats and impairments to the designated uses were ranked by the Fumee Creek Watershed Council and the Watershed Project Manager using information collected through surveys, personal contacts, chemical and physical water testing, and visual inventory of the watershed. **The terms "impaired" and "threatened" used in this plan relate to the perception of relative severity of impacts upon a designated use as judged by visual survey, public input, limited chemical and biological testing during the two year development of the Fumee Creek Management Plan. The Michigan Department of Environmental Quality reserves the right to assign these designations according to the findings of their own test methods and may not be identical to impact levels identified in this plan.**

The following is a prioritized list of the impaired/threatened designated uses in the Fumee Creek Watershed ranging from most critical (1) to least critical (9). Decisions on the designated use rankings were based on the significance of that designated use in the watershed, the number of watershed concerns that threaten the designated use, Fumee Creek Watershed Council input, and the ability to enforce changes on the local level that are not directly associated with state and federal environmental regulations. Additional information used in the ranking of designated uses was gathered from water quality testing, benthic invertebrate sampling, temperature logger data, and visual assessment of the watershed.

Designated Use	**Fumee Creek Watershed Status**
1. Coldwater Fishery	Impaired
2. Warmwater Fishery	Threatened
3. Other indigenous Aquatic Life	Threatened
4. Total Body Contact Recreation	Threatened
5. Partial Body Contact Recreation	Threatened
6. Industrial Water Supply	Threatened
7. Navigation	Impaired
8. Agriculture	Threatened
9. Public Water Supply	Threatened

The "impaired" status was given to the cold water fishery designated use, based on the reported decline of coldwater species to be found in stretches of three streams that were listed as second quality trout feeder streams in the Menominee River Basin Study (1992). Because cold water streams are relatively uncommon in much of Michigan, it was deemed important to try to protect or restore that use if possible. The "impaired" designation received for the navigation designated use is based on visual assessment of excessive non-native and native aquatic plant growth that restricts boat traffic on Cowboy Lake and the Menominee River. The remainder of the designated uses were listed as "threatened" based on concerns over the present state of various waters and increasing impacts of the urban environment. There have been no waterbodies in the watershed listed by the State of Michigan as exceeding any of the Total Maximum Daily Load (TMDL) standards for surface waters of the State. It should be noted that mercury pollution of surface waters is a growing concern. The State of Michigan has called for a statewide fish advisory that suggests consuming only certain numbers of various fish species based on a person's age and sex. These advisories could lead to future TMDL listings and could cause an impairment classification to the fisheries and other aquatic life designated uses.

Desired Uses of the Fumee Creek Watershed

Many of the desired uses in the watershed that were determined through input by area residents in surveys and personal communication at information and education events. The Fumee Creek Watershed Council and watershed municipalities also provided a significant amount of input about the desired uses. In addition to addressing/correcting the perceived threats to designated uses above (cold and warm water fisheries, etc.), several specific suggestions for improvements to designated uses were made by area stakeholders. Most of them demonstrate a close relationship with recreation and water quality.

1) City of Norway Trail System: incorporate and enhance areas along the Whites Creek Corridor.
2) Support a Dickinson County Trail System that connects natural areas such as Fumee Natural Area and recreation areas such as Piers Gorge.
3) Develop additional nature and educational trails.
4) Enact zoning ordinances to cover on-site stormwater treatment, larger waterfront setbacks, restoration of riparian corridors.
5) Protect current wetland areas and start a wetland mitigation bank for use in situations where pockets of wetlands are developed.
6) Improve the Mud and Crystal Lake areas in Iron Mountain to include increased wildlife viewing and recreation opportunities.

Narrative of Specific Threats to Designated Uses

Coldwater Fishery

Coldwater fish species (i.e. trout) are much more sensitive to changes in the aquatic environment. Sedimentation, temperature, and dissolved oxygen content are the most crucial factors in reducing available habitat as well as degrading the water quality necessary for survival of coldwater species. The MDNR publication "Designated Trout Streams for the State of Michigan" (Order FO-210.01) classifies the entire stream lengths of Fumee Creek, Poor Farm Creek, and Jones Creek as coldwater systems. Only personal communication contacts from local residents confirm the historic presence of trout in these waters. Information about fish species present in these waters extend only to that of personal communication accounts from local residents. The coldwater fishery use was designated **impaired** based on local observations and temperature logger information placed in the three streams. (See Appendix G for temperature logger data.) Bob Forgette Sr. used the two ponds (Dawn's Lake) at Whitebirch Mobile Home Park near the headwaters of Poor Farm Creek to begin one of the first commercial trout fisheries in the State of Michigan. The present park manager has stated there have not been reports of trout in these lakes for over 5 years. These ponds accept U.S. 2 road run-off and stormwater that travel through mine tailings and an auto salvage yard. They turn bright orange after most rainfalls.

Warmwater Fishery

The Fumee Creek Watershed Project did not conduct any studies on fish species composition in any of the main creeks or lakes in the watershed. Nor were there any past studies performed or other related information found on the species composition of the creeks in the watershed. Various pieces of information about fish species is available for the Menominee River, Cowboy Lake, Fumee Lake, and Strawberry Lake from the Michigan Department of Natural Resources, Wisconsin Electric, Fumee Lake Commission, and City of Norway. For this reason it would be unfounded to say that this designated use is impaired. However, the visual, physical, and chemical data collected during the planning phase of the 319 watershed grant indicate that the warmwater fisheries of various lakes and streams are **threatened**.

Other Indigenous Aquatic Life and Wildlife

Aquatic invertebrates hold an important role in the food web of aquatic systems and are susceptible to changes in water chemistry and habitat. Many of these insects reside in the water for up to one year before continuing their adult life out of the water. For this reason, aquatic invertebrates are often used as an indicator of water quality. They can reflect long term water quality impairment concerns based on abundance of species and community composition. Fumee Creek and White Creek received slightly impaired water quality ratings in The Menominee River Basin Study (1992) used the MDEQ "GLEAS" Procedure 51 to rate aquatic invertebrate communities in Fumee Creek and White Creek. Both creeks were rated slightly impaired. The Pine Creek Sand Trap was used as the "Best Available" condition in which these sites were compared. The "GLEAS" procedure 51 would be undertaken in the watershed to verify the previous rating, but it was felt safe to say that this designated use was at least **threatened**. Information relating to benthic macroinvertebrates in Fumee Creek Watershed are found in Appendix F.

Total Body Contact Recreation Between May 1 and October 31

Under normal flow conditions, there is no data that suggests that waterbodies of the Fumee Creek Watershed does not meet water quality standards for the total body contact designated use. White Creek and the Menominee River may see this designated use **threatened** from bacteria and pathogens due to the location of the Norway Wastewater Treatment Plant and the Iron Mountain/Kingsford Wastewater Treatment Plant. All three communities have undergone extensive storm sewer separation projects in recent years but still maintain sections of the system that are combined sanitary sewers and stormwater sewers. Due to the combined nature of sections of the sewer large rainfalls create situations where the wastewater treatment plants cannot handle all of the water that needs treatment and therefore must discharge the overflow to a receiving waterbody. When this occurs the overflow water is screened to remove large solids and then the water is chlorinated to help purify the water. The Norway Treatment Plant on White Creek has only few overflows each year while the Iron Mountain/Kingsford Treatment Plant can overflow in rain events that are just less than one inch in a 24-hour period.

Sewer systems where the stormwater and sanitary sewer lines have been separated have the potential to **threaten** the partial body designated use as well. Often times, when the sewer systems were separated, the stormwater is discharged directly to a nearby lake or steam. In most places this stormwater receives treatment through traditional in-line catch basins that only remove some of the course sands and other large material. Direct discharge to a waterbody may therefore carry harmful substances like heavy metals, oils, greases, sediment, nutrients, and bacteria. It is suggested that measures be taken by the municipalities to improve stormwater treatment through the use of sediment basins, infiltration practices, and retention/detention basins. Watershed municipalities would also benefit the surface water resource by enacting new stormwater management ordinances that require individual landowners to provide for stormwater storage and treatment prior to discharging water to the municipal stormwater system.

Total body contact will continue to be threatened in the future as exotic species spread in range, become more prolific in some waterbodies, and new exotics are introduced in the watershed. Eurasian Watermilfoil is currently threatening this designated use by creating dangerous swimming and wading conditions. The Eurasian Milfoil has become so thick in Cowboy Lake that becoming entangled in the Milfoil beds continues to impair swimming opportunities. The spread of Zebra Mussels is an imminent danger facing the Fumee Creek Watershed. Zebra Mussels attach themselves to any hard surface and dead Mussels can be found on the lake bottom and along shorelines. This situation creates the threat of injury to swimmers by cutting their skin and creating foul smells on the shoreline.

Partial Body Contact

Partial body contact recreation may also be **threatened** for the same reasons stated under total body contact recreation.

Navigation

All of the creeks in the watershed are small enough in size that it is probable that the navigation designated use would not be associated with these waterbodies even for recreational purposes. Sediment additions from stormwater and riparian erosion sites would **impair** this designated use by decreasing the depth of the stream channels and causing them to erode their banks and widen the channel. The Menominee River, its impoundments, and the lakes in the watershed would condone canoeing and boating due to their size and depth. Cowboy Lake is the one instance in the watershed where navigation is **impaired**. Cowboy Lake receives substantial boat traffic from the lakeshore residents and other recreational users that utilizes the Menominee River connection to enjoy the fishing and dining at the Blind Duck Restaurant.

Area residents and the City of Kingsford have expressed concern over the severe increase of aquatic vegetation in the lake over the last few years. Also of concern is the presence of Eurasian Watermilfoil in small pockets. This non-native invasive plant and other native plants dominate much of the lake surface area causing the failure of boat motors when becoming tangled with vegetation. Although chemical water testing did not indicate elevated nutrient levels in the lake there are obvious sources identified by visual observation and personal communication from lake users. Sources of nutrient additions to the lake have a high probability of coming from the multiple lakeshore residents have high maintenance lawns that receive regular fertilization throughout the year. Many of the same residencies lack a riparian buffer to filter runoff carrying excess nutrients prior to entering the lake.

Industrial Water Supply

Two paper mills and three hyrdroelectric dams utitlize the Menominee River. Future development of the already urbanizing watershed could create potential needs for the commercial use of surface waters in the manufacturing process. Sedimentation of our lakes and streams and the introduction and spread of exotic species threaten the Industrial Designated Use. Excessive erosion and sedimentation of lakes and stream can add substantial cost by imposing a needed treatment process to remove sediments. Sediment laden water may also damage water transport equipment. The future use of waterbodies (especially the Menominee River) as an industrial water supply was designated as **threatened.**

Agriculture

Agriculture comprises a relatively small percent of the land use in the watershed, but three sites were identified as potential contributors of nutrients, bacteria, pesticides, and/or biological oxygen demand. All are in close proximity to surface water. Runoff traveling through unconfined manure at Oak Crest Stables and entering a ditch that feeds into White Creek poses one threat. Containment and filtering of wastes generated seasonally from four barns at the Dickinson County Fairgrounds is a second threat to White Creek. Unconfined wastes and manure application at a 40 head beef operation that drains to the Menominee River is the third concern.

Public Water Supply at the Point of Intake

The water supply designated use is probably held to the most stringent water quality standard. Municipal and private wells supply the citizens in the entire Fumee Creek Watershed area its drinking water. For this reason, water quality testing during the watershed project planning phase was not guided to determine the suitability of surface water sources for human consumption. Stormwater discharges occur in several of the waterbodies in the watershed including; White Creek, Strawberry Lake, Lake Mary & View (Norway), Fumee Creek (at U.S. 2), Poor Farm Creek, Jones Creek, Crystal Lake, and East and West Chapin Lakes. >The nature of urban stormwater makes it a likely source of pollutants such as sediment, nutrients, and toxic materials like heavy metals, oils, and greases that contribute to threatening this designated use.

Breitung Township is currently in the process of developing a wellhead protection program to ensure that drinking water sources remain safe for consumption. Iron Mountain once maintained a filtration plant near Lake Antoine that utilized the lake water and water pumped from the Chapin Lakes as the public water supply. Since the closure of the filtration plant the City has increased the amounts of stormwater entering these water bodies significantly. It is likely that reopening these public water supplies in the future would prove to be more challenging and expensive to meet drinking water standards if the idea is feasible at all.

Until 1988, the City of Norway used Forest Lake (now located in the Fumee Lake Natural Area) as its drinking water source. The lake source was abandoned and switched to wells because of the costs to maintain and upgrade the system to abide by new regulations. Forest and Fumee Lakes continue to be the most probable waterbody to meet drinking water standards because of the lack of land use pressures impacting the water.

Figure 10. Pollutants, Sources and Causes Known (k) or Suspected (s) to Threaten or Impair the Fumee Creek Watershed

Pollutants	**Sources**	**Causes**
Debris & Litter (k)	Storm Drains (k)	Traditional in-line catch basins are ineffective at detaining debris (k)
	Illegal dumping by residents (k)	Lack of disposal areas and cost (s)
Depressed dissolved oxygen (BOD) (k)	Groundwater pump discharge (k)	Direct pip discharge of low oxygen groundwater (k)
	Residential fertilizer use (s)	Direct stormwater discharge to lakes & streams (k)
		Improper application (s)
Hydrologic flow fluctuations (k)	Groundwater pump discharge (k)	An "On or Off only" pump design (k)
	Urban stormwater (k)	Poor stormwater management practices (k)
		Increasing amount of impervious surfaces (k)
Nutrients (k) Nitrogen & Phosphorus	Residential fertilizer use (s)	Lack of riparian buffer b/w lawn and waterbody (k)
		Direct stormwater discharge to lakes & streams (k)
		Improper application & over use (s)
	Sediment deposition (k)	**See sediment pollutant information

	Combined sewer overflows (k)	Large areas remain to be serviced by combined sewer systems for sanitary and stormwater sewers (k)
	Breakdown of drained organic soils (s)	Current channelized location of White Creek reduced wetland area. Muck soils are now decomposing and leaching nitrates into the groundwater and creek (s)
Oil and Grease (k)	Storm drains (k)	Poor stormwater management practices (k)
	Impervious surfaces (k)	Improper vehicle maintenance and fluid disposal (s)
		More roads, buildings, and parking lots due to development (k)
Sediment (k)	Urban stormwater (k)	Poor stormwater management practices (k) Lack of catch basin maintenance & cleaning (k)
	Poor construction practices (k)	Lack of regulations enforcement (k) Lack of maintaining erosion control practices (k)
	Eroding streambanks (k)	Human access (k) Flow fluctuations (k)
	Eroding recreation trails (k)	Unrestricted and unguided access on steep slopes (k)
	Eroding road-stream crossings (k)	Improperly sized culverts due to increased hydrologic flow (k)
		Lack of turnouts and other erosion prevention BMPs (k)
Bacteria & Pathogens (k)	Waste Water Treatment Plant Overflows (k)	Remaining areas with combined sanitary and stormwater sewers creates overflows during large rain events at the Iron Mountain/Kingsford and Norway plants (k)
Metals (s),Salts (s)	Storm drains (s)	Poor stormwater management practices (k)
	Impervious surfaces (s)	More roads, buildings, and parking lots due to development (k)
	Atmospheric & natural occurrence (s)	Natural causes (s)
	Improper snow disposal (s)	Direct dumping of stockpiled parking lot snow into waterbodies (k)
Temperature (s)	Urban stormwater (s)	Warming of precipitation and runoff from increasing amount of impervious surfaces (s)
	Riparian development (s)	Conversions fo shade providing riparian vegetation to turf grass (s)

Watershed Goals

Based on pre-inventory perceptions and resource concerns the following goals were set to mitigate the threatened or impaired uses in the watershed.

Figure 11: Initial Watershed Goals

Impaired Uses*	**Goal**
Coldwater Fishery	Restore coldwater fishery in three streams by reducing the amount of sediment, nutrients, urban stormwater, and fluctuating of hydrologic flows
Navigation	Improve navigation by the same means as the industrial water supply
Threatened Uses*	**Goal**
Warmwater Fishery	Restore the warmwater fishery in the same manner as above
Aquatic/other wildlife	Restore habitat for aquatic and other wildlife by same means as above plus enhancing the riparian corridor
Total/Partial Body Contact	Restore recreational opportunities by reducing the amount of bacteria, nutrients, and exotic species
Industrial Water Supply	Improve the industrial water supply by reducing the amount of sediment, nutrients, and exotic species in water

*** The terms impaired and threatened used in this plan relate to the perception of relative severity of impacts upon a designated use as judged by visual survey, public input, limited chemical and biological testing during the two year development of the Fumee Creek Management Plan. The Michigan Department of Environmental Quality reserves the right to assign these designations according to the finding of their own test methods and may not be identical to impact levels identified in this plan.**

III

Fumee Creek Watershed Critical Area

A critical area is defined as the geographic portion of the watershed that is contributing a majority of the pollutants and as having a significant impact on the waterbody.

The number, size, and length of creeks in the Fumee Creek Watershed are relatively small in comparison to the overall size of the watershed. Land uses throughout the watershed were considered in determining critical areas of potential pollutant contribution in the watershed. During the visual inventory of the watershed three separate zones of critical areas were classified. Particularly looked at were locations of sediment loading, stormwater outlets, and significant human impacts on recreational areas were observed.

1. The first critical zone is the ¼ mile area immediately adjacent to either side of a creek or lake. Areas next to a waterbody are most likely to contribute pollutants to that system merely by runoff entering the lake or creek from neighboring landuses.

2) Rapidly urbanizing zones or those with high human impact, such as the U.S. 2 Corridor, Breitung Cutoff Road, Fumee Falls, Recreational Trails. These areas may contribute pollutants from greater than a ¼ mile distance due to poor stormwater management practices.

3) All areas drained by storm sewer systems that directly discharge to surface waters without further treatment methods.

4) Areas with steep topography and highly erodible soils, or with low infiltration rates can also be a significant problem. Several areas in the Fumee Creek Watershed will be issues in the future as urban areas expand into land less suitable for development.

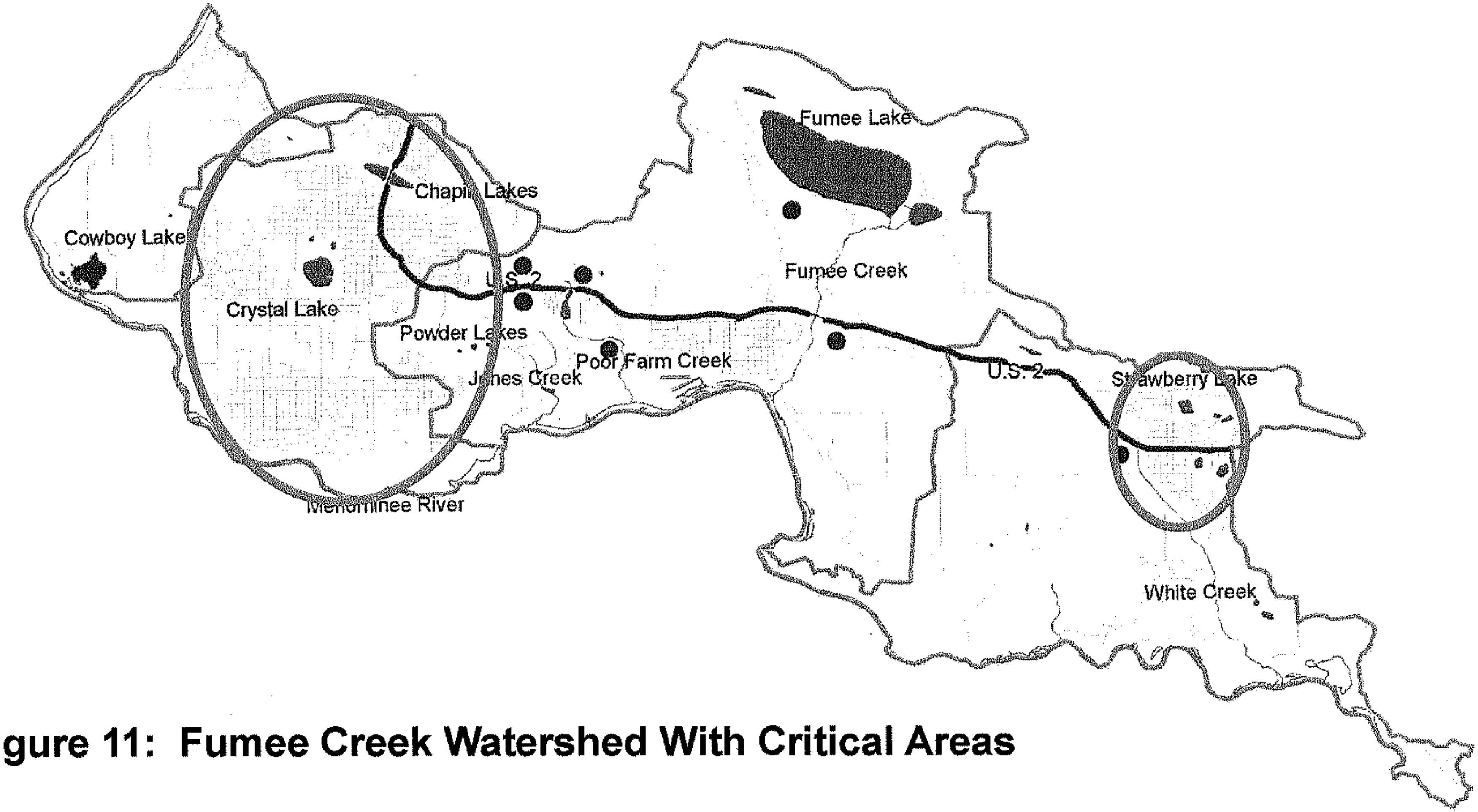


Figure 11: Fumee Creek Watershed With Critical Areas

Rapidly Urbanizing Zones/High Human Impact

U.S. 2 Corridor

1/4 mile adjacent to water bodies

Areas Drained by Storm Sewer Systems

IV
Watershed Inventory

Based on an inventory of the watershed using several tools, a list of identified pollutants known (k) or suspected (s) to impact Fumee Creek Watershed include:

- Sediment (k)
- Nutirents (s)
- Oils, greases, salts, heavy metals (s)
- Hydrologic Flow (k)
- Biological Oxygen Demand (k)
- Exotic Species (k)
- Pesticides (s)
- Bacteria/Pathogens (s)
- Temperature (k)

Identified sources for each pollutant after the visual inventory of the watershed are summarized below:

Figure 13. Inventoried Pollutants and Sources

Pollutants	Sources
Sediment	channelization of stream unstable stormsewer outlets untreated runoff from impervious surfaces undersized culverts unstabilized slope at road crossings human access unstable unarmored ditches improper grading lack of buffers on lakes & streams unstabilized slopes unprotected shoreline flow fluctuation uncontained animal waste
Nutrients	Runoff from impervious surfaces Improper use of fertilizer poorly functioning septic systems Uncontained animal wastes Animal access to waterbodies

Hydrologic flows	Undersized stormwater conveyance channels lack of detention of runoff
Depressed DO (BOD)	Poor stormwater management practices Low oxygen content groundwater being pumped
Temperature	Heated stormwater runoff discharge directly to waterbodies Not enough shade next to stream banks and waterbodies Sediment reducing depth of stream channels & lakes
Exotic Species	Lack of public education and identification
Bacteria & Pathogens	Overflows from combined stormwater & santiary sewers Poor stormwater management practices Lack of animal waste systems to manage wastes
Oil, grease & metal	Poor stormwater management practices Impervious surfaces Improper vehicle maintenance and fluid disposal
Debris & Litter	Poor stormwater management practices Lack of disposal areas and cost

Locations and impacts from the various sources/pollutants are detailed below.

1) Sediment

The natural processes of erosion and sedimentation have been shaping the surface of the Earth since the beginning of geologic time. Erosion is defined as the detachment and transport of material by gravity, ice, wind, and water and sedimentation is the deposition of the material (Wildland WS Mgmt). Once this particulate material is in transport it is called sediment and sediment has the ability to cause several negative water quality affects (Wildland WS Mgmt). In fact, worldwide, sedimentation of streams is the most widespread cause of water quality degradation in forested watersheds and is typically a substantial pollutant in other watersheds as well.

Watershed management is primarily concerned with the anthropogenic born sediment because it is in addition to naturally occurring erosion and sedimentation in the system. Water quality degradation from sediment pollution can impact several different aspects of the aquatic environment for humans and animals. Below is an extensive list of those impacts.

- Increased danger for swimming and wading.
- Increased maintenance and costs for maintaining and dredging of ditches, dams, reservoirs, marinas, storm sewer systems, and waste water treatment plants (if combined sewers).
- Reduced recreational capacity for boating, swimming, and fishing.
- Overall decrease in aesthetic value and possible property values.
- Drinking water treatment costs may increase.
- Fine sediment in irrigation water can clog soil pores and reduce the infiltration capacity of the soil. Irrigation systems may also become clogged.
- Suspended solids absorb more heat from sunlight, which increases the water temperature.
- Deposited sediment can make lakes and streams shallower, which increases the ability for sunlight to increase the water temperature and reduce the time needed for the temperature change.
- Increases in water temperature decrease the levels of dissolved oxygen because warmer water holds less oxygen than colder water.
- Filled in stream beds often are widened through erosion of the outer banks in an effort to maintain the same channel flow volume. Water flow may be slowed in a wider channel.
- Deep pools are filled in with unconsolidated material. These pools are usually where fish find refuge in cool, calm water.
- Less sunlight penetrates the water column so photosynthesis decreases and less oxygen is produced by plants and algae.
- Excess sediment will eventually settle out and cover the bottom of the waterway.
- Bottom substrate material such as gravel and woody debris is crucial habitat for many aquatic insects that fish use as a primary source of food.
- Fish lay eggs in gravel substrate because the greater velocity and turbulence of the water creates a high oxygen environment and it removes waste products of the embryos and larvae.

- Suspended solids can directly harm fish by abrading or clogging fish gills, reducing aquatic organism growth rates, increasing organism stress, and lowering disease resistance.
- Turbid water reduces the ability for aquatic organisms to find food.
- Natural movements and migrations of aquatic populations may be disrupted.
- Nutrients adsorb to sediment and are carried into waterbodies when deposited. Nutrient enrichment of (called eutrophication) waterbodies can leaded to accelerated lake aging and an increase in algae.
- Nutrient additions increase the Biochemical Oxygen Demand and reduce the oxygen levels.
- Pesticides enter waters adsorbed to sediment.
- Heavy metals, oils, and greases can also be carried to waterbodies through sediment deposits.

Michigan Water Quality Standards (Part 4 Rule 50 of Part 31, Water Resources Protection, of Act 451 of 1994) sets a "narrative standard" for Total Suspended Solids with no threshold to determine a pollution violation. However, the standards do allow for enforcement through the statement that "waters of the state shall not have any of the following unnatural physical properties in quantities which are or may become injurious to any designated use: turbidity, color, oil films, floating solids, foam, settleable solids, suspended solids, and deposits."

Sources: Chapter 10-Water Quality; Wildland WS Mgmt; DEQ Water Quality Parameters

Turbid, or dirty looking, water is the easiest indicator that there has been an influx of excess sediment into a waterbody.

2) Nutrients – Nitrogen & Phosphorus

Point source discharges are regulated by Michigan Water Quality Standards (Part 4 Rule 60 of Part 31, Water Resources Protection, of Act 451 of 1994) to achieve 1 milligram per liter of total phosphorus as a maximum monthly average effluent concentration. Section 2 of Rule 60 addresses non point source plant nutrient pollution impacts by saying that "nutrients shall be limited to the extent necessary to prevent stimulation or growths of aquatic rooted, attached, suspended, and floating plants, fungi, or bacteria which are or may become injurious to the designated uses of the waters of the state.

Nutrients and other dissolved substances in water originate from the geologic weathering of rocks, biological inputs or photosynthetic conversion of inorganic substances to organic materials, and meteorological events (Ch. 10-Water Quality). Aquatic and terrestrial plants need nutrients such as Calcium, Magnesium, Manganese, Nitrogen, Phosphorus, Potassium, and Sodium for survival and growth. The fact that water acts as a universal solvent allows these substances to be easily transported and available for plant uptake (Wildland WS Mgmt).

Phosphorus:

Nitrogen and Phosphorus are generally the two nutrients monitored for the most in aquatic systems. Phosphorus concentrations in water are extremely important because it is a naturally scarce nutrient in aquatic ecosystems and acts as the "limiting" nutrient (DEQ-Phosphorus). Plants and algae quickly remove any free phosphorus in the water. Regardless of the amount of nitrogen in the water plant growth stops when all the phosphorus is used up (DEQ-Phosphorus).

Phosphorus scarcity in water is in part due to its high attraction to organic matter and soil particles found on land (DEQ-Phosphorus). Therefore land use management decisions may have a significant impact on the quality of surface waters.

Excessive loading of phosphorus into surface waters can create undesirable algae blooms and an overpopulation of other plants. Excessive plant and algae populations can potentially lead to low dissolved oxygen content in surface waters. During the daytime plants create oxygen through photosynthesis. At night however, plants and algae use up available oxygen through respiration and do not replace that dissolved oxygen until the sunlight appears again and photosynthesis resumes (DEQ-Phosphorus). Additionally, plant growth creates more dead plant material available for bacterial decomposition and causes a further reduction in dissolved oxygen (DEQ-Phosphorus). Lowered dissolved oxygen levels could lead to fish kills and a change in species composition.

Nitrogen

Nitrogen occurs in several forms such as ammonia, gaseous N, nitrite-N, and nitrate-N. Sources of nitrogen in waterbodies include fixation of nitrogen gas by certain bacteria and plants, organic matter additions, inorganic fertilizers, and the weathering of rocks (Ch. 10 Water Quality). Organic N (and gaseous N_2 is either broken down or converted into) breaks down into ammonia (NH_3) and the ammonia is then oxidized into nitrate-N (Ch. 10-Water Quality). Nitrate-N (NO^-_3) and ammonia are usable forms of nitrogen for plant growth.

Therefore, excess nitrate-N and ammonia can potentially have negative impacts on water quality by causing eutrophication, spurring more plant growth, and increasing biochemical oxygen demand.

Overall, forms of nitrogen are much more abundant in nature than phosphorus and will rarely limit plant growth (Field Manual-WQ Monitoring). In high enough concentrations, nitrate-N can promote excessive growth of algae and plants in an aquatic system. If phosphorus is available in the same system, only 0.30 mg/ l of nitrate-N can cause an algal bloom (Ch. 10-Water Quality). Nitrate-N levels over 4.2 mg/l can negatively impact some fish species. The United States Environmental Protection Agency set 10 mg/l as the limit for nitrate-N in drinking water largely in part of methemoglobina or "blue baby syndrome" that restricts a baby's blood from carrying oxygen if drinking water nitrate levels go over 45 mg/l (Ch. 10-Water Quality).

Human created sewage from wastewater treatment plants, effluent from illegal sanitary sewer connections, and from failing or improperly maintained septic systems is some of the main sources of nitrates from human action. Agricultural land uses have the potential to add nitrates to surface waters through the use of fertilizers and from cattle feedlots, dairies, and other livestock activities. Urban and residential areas along riparian areas or areas serviced by stormwater systems can also be a major contributor of nitrogen pollution through the use of fertilizers on lawns and gardens (Field Manual-WQ Monitoring).

3) Hydrologic Flow

The hydrology of any given river system is defined by the processes of the hydrologic cycle. Mathematically, the hydrologic cycle can be explained by the following equation: precipitation = evaporation + riverflow + storage (Water Quality Field Monitoring Manual-pg. 61). It is this equation that determines the amount of water available to flow through a river system of a particular region.

Climate and Geology are the two primary factors that directly influence the hydrologic flow of a river (Water Quality Field Monitoring Manual-pg. 61). The climate of a region governs the amount of precipitation, the source of the water, the air temperature, and physical state of the water as if falls to the ground. Geology defines the topography of the watershed landscape and determines the soil types found in an area with the available parent material. In turn, the geologic factors of topography and soil type determine the land cover and vegetation type found in areas of the watershed. (and determines where and how the water flows to the stream channels.)

Stream channels are in a continually changing and delicate balance as a result of the affects of these hydrologic factors. Alterations of any of the hydrologic factors will usually result in the stream making adjustments in order to compensate for the changes. Human development in a watershed, if it is not carefully planned with water resources in mind, can cause severe damage to lakes and streams.

Development inevitably carries with it a significant amount of impervious surfaces. These hard surfaces create more surface runoff that traditionally occurred in the watershed by not allowing water to infiltrate into soil and be used by the vegetation or stored as groundwater. Streams receive cool groundwater inputs on a slow, steady, and continual basis that maintains a constant level of flow. When the groundwater inputs are reduced the streams and its inhabitants are harmed by less depth, less flow, and higher temperatures.

Increasing development and impervious surfaces also creates another detrimental affect on the hydrology of a stream system. Often times the increase in runoff volumes necessitates the development of a storm sewer system to remove the water from street and parking lots to reduce the impacts of flooding and increase safety for the residents of a watershed. The storm sewers typically discharge the runoff water to a wastewater treatment plant or, much more commonly, directly to the nearest lake, stream, or river. Unless this stormwater is detained and released slowly there can be a large input of water being discharged to a stream in a short period of time. Extensive storm sewer systems could also carry water from areas of a watershed that might not ever reach a stream by overland runoff.

Fast developing watersheds usually see significant changes in hydrologic flow to the point where it is considered a type of pollutant. Lower base flows in streams and larger flood flows during storms are typical results in urbanizing watersheds. The reduction in groundwater impacts the amount of flow and often times a network of storm sewers to carry runoff to the nearest lake or stream.

These affects from land development can create other negative changes such as sediment covering beneficial gravel habitat, sediment filling in deep pools, scouring and increasing the depth of the stream channel, eroding streambanks, wider and shallower stream channel, reduced biological diversity, shift from desirable fish species to undesirable species, and reduced recreational value. In severe cases, a stream that once flowed year round may actually only flow when it rains and the storm sewers are discharging water.

4a) Dissolved Oxygen

Much like the terrestrial environment, aquatic organisms require dissolved oxygen to survive. Different species of fish and insects require varying amounts of dissolved oxygen to survive. Steady, high levels of oxygen generally indicate a healthy system capable of supporting a diverse array of aquatic species (Field Manual-WQ Monitoring). Conversely, sudden or long-term gradual reduction in dissolved oxygen may cause a pollution intolerant species population to shift to a pollution tolerant species population (Field Manual-WQ Monitoring).

There are only two ways in which oxygen enters a lake or stream. Plants and algae produce oxygen as they undergo photosynthesis. Oxygen also enters across the air-water interface and is increased as turbulence at the surface is increased. Water temperature, salinity, and pressure are the three factors that determine the amount of oxygen that can be dissolved in water. Of the three factors temperature is usually the one of most concern because human actions of removal of riparian vegetation, stormwater discharges, and sedimentation can create the most change. Colder water holds more oxygen because gas solubility increases with decreasing temperature. (DEQ-DO for the paragraph)

Depletion of oxygen levels in a waterbody may be due to a rise in water temperature, respiration of plants and animals, and the use of oxygen by aerobic microorganisms that decompose organic matter present in the water (DEQ-DO). A diurnal variation of oxygen levels may also occur when excessive populations of plants and algae are producing oxygen during the day (photosynthesis) and using oxygen at night for respiration (DEQ-DO). This diurnal variation is further enhanced by additions of organic matter that drives an increase in the oxygen-using microbial population that breaks down this material.

Michigan Water Quality Standards Part 4 Rule 64 of Part 31, Water Resources Protection, of Act 451 of 1994 state that surface waters designated as coldwater fisheries must meet a minimum dissolved oxygen standard of 7 mg/l, while surface waters protected for warmwater fish and aquatic life must meet a minimum dissolved oxygen standard of 5 mg/l.

4b) Biochemical Oxygen Demand (BOD)

Biochemical oxygen demand is very closely related to dissolved oxygen when monitoring water quality. Aerobic microorganisms break down dead aquatic plants and organic matter into more stable components that are useable to other aquatic species (Ch 10-Water Quality). (so that this material may be transformed into useable forms on nutrients.) The microorganisms use dissolved oxygen during the decomposition process called oxidation (Field Manual-WQ Monitoring). BOD is a measure of the quantity of oxygen used by microorganisms during the decomposition of organic matter.

Anytime excessive amounts of organic matter as well as nutrients such as nitrate and phosphate are added to the water, the growth of aquatic plants will be stimulated. The increase in plant growth leads to an inevitable increase in plant material that must be decayed. The result is an increase in the microorganism population needed to decay the material and an increase in the diurnal variation (discussed in the oxygen section) of the oxygen levels (DEQ-BOD). If levels of dissolved oxygen drop below 5 mg/l, intolerant species become stressed. Fish kills can result if dissolved oxygen drops below 2 mg/l for over two hours. The aquatic environment may go anaerobic (without oxygen) at levels below 1 mg/l and could mean death to nearly all the aerobic organisms present (DEQ-DO).

Natural sources of organic material include vegetation additions from the riparian area, aquatic plants, and water drainage from organic rich swamps and bogs. Point sources of organic matter pollution may come from wastewater treatment plants, meat and food processing plants, and paper mills. It is the nonpoint sources that increase BOD that this watershed management plan is concerned with. These human induced sources of organic matter pollution include livestock operations, agricultural runoff, failing septic systems, and urban runoff (organic matter and fertilizers).

Michigan Water Quality Standards Part 4 Rule 64 of Part 31, Water Resources Protection, of Act 451 of 1994 state that surface waters designated as coldwater fisheries must meet a minimum dissolved oxygen standard of 7 mg/l, while surface waters protected for warmwater fish and aquatic life must meet a minimum dissolved oxygen standard of 5 mg/l.

> When aquatic plants die and other organic materials are added to the water, aerobic microorganisms begin to break this material down and oxidize it. The oxidation process uses oxygen, depleting it from surrounding waters.

4) Temperature

Temperature extremes and changes brought on by human induced change is called thermal pollution. There are three common sources of thermal pollution in the Fumee Creek Watershed. Urban stormwater runoff during the summer carries warmed water from sun heated impervious surfaces such as streets, roofs, and parking lots directly to lakes and streams. Soil erosion creates cloudy, dark water bodies that attracts more sunlight and warms the water temperature. Deposited soil has reduced the depth of lakes and streams and in some cases streams have become wider making it easier for sunlight to warm the water.

Development of shoreline land continues to remove riparian vegetation that is important for providing shade and protecting the water from the warming affect of direct sunlight on the waterbody.

Water temperatures can control the survival of different plants and animals in a waterbody. Scientists classify rivers as warm water and cold water systems and therefore they are capable of supporting a certain composition of fish species. Major coldwater fish species include trout, salmon, whitefish, and cisco while warmwater fish species include bass, pike, walleye, and panfish. An ideal water temperature for trout is about 62 degrees Fahrenheit and temperatures above 78 degrees Fahrenheit could be lethal (Better Trout Habitat). Warmwater fish species have a greater range of water temperature tolerance. Temperature extremes or long term changes can potentially affect the type, quantity, and well being of the plants and animals that reside in a waterbody. Often times a change in species composition occurs toward a less desirable community (Ch. 10 Water Quality) (Significant alterations in water temperature or long term changes could bring a change in the species that reside in a waterbody. Often times the change is toward less desirable fish and insect community.)

Increases in temperature generally causes an increase in an aquatic organisms biological activity which places a greater demand on the amount of food and dissolved oxygen resources they needed to survive. The added stress on the organisms may also lead to an increase in vulnerability to toxic compounds, parasites, and diseases.

Raising temperatures also increase the rate of photosynthesis and plant growth and can lead to algae blooms. More plant material must be decomposed by oxygen using bacteria when these plants die and can further reduce dissolved oxygen levels (www.michigan.gov, Water Quality Parameters).

Michigan Water Quality Standards state that (Part 4 Rules 69 through 75 of Part 31, Water Resources Protection, of Act 451 of 1994) inland lakes shall not receive a heat load which increases the temperature of the receiving water more than 3 degrees Fahrenheit above the existing natural water temperature at the edge of the mixing zone. The heat load shall not increase the temperatures greater than the maximum monthly temperatures in **Figure 14** . These standards also state that rivers, streams, and impoundments in this region shall not receive a heat load which increases the temperature of the receiving water at the edge of the mixing zone no more than 2 degrees Fahrenheit for coldwater fisheries, and 5 degrees Fahrenheit for warmwater fisheries. The heat load shall not increase the temperatures greater that the maximum monthly temperatures for warmwater and coldwater fisheries **Figure 14.**

Figure 14. Michigan Water Quality Standards for Max Monthly Temps for Cold and Warm Water Fisheries.

Month	Jan.	Feb.	Mar	Apr	May	June	July	Aug.	Sept.	Oct	Nov.	Dec.
Temperature (°F)	45	45	50	60	70	75	80	85	80	70	60	50
(°C)	7.2	7.2	10	15.6	21.1	24	27	29	27	21	15.6	10

Maximum Monthly Temperatures for Michigan Coldwater Rivers, Streams, and Impoundments

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (°F)	38	38	43	54	65	68	68	68	63	56	48	40
(°C)	3.3	3.3	6	12	18	20	20	20	17	13	9	4.4

Maximum Monthly Temperatures for Michigan Warmwater Rivers, Streams, and Impoundments

Month	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (°F)	38	38	41	56	70	80	83	81	74	64	49	39
(°C)	3.3	3.3	5	13	21	27	28	27	23	18	9.4	3.8

7) Exotic Species

Aquatic and terrestrial non-native plant and animal species have continued to be a growing concern in the United States for economic and environmental reasons. A non-native species is one that occurs outside of the area that it originally evolved (Plants Out of Place-USDA NRCS). These species are often referred to by other names such as exotic, introduced and alien species.

Not all non-native species are a nuisance and many have great value for use in agriculture and for aesthetic purposes. However, there are some plant and animal species that thrive in their new surroundings and are referred to as invasive or noxious species. Once outside their original habitat, invasive non-native species have the ability to quickly dominate its new habitat.

Natural controls that native plants continue to battle like disease, fungi, insects, herbivores, and competition from other plants are no longer governing the growth and spread of non-native species (Plants Out of Place-USDA NRCS). Other characteristics that further enable the invasive species to accomplish dominance of their habitats include fast growth, longer growing season, allelopathic affects to surrounding plants, prolific seeding, and they are very adaptable to a wide range of habitats.

At the present time, waterbodies in the Fumee Creek Watershed are threatened by three different invasive aquatic species. In the spring of 2001, plant samples from Cowboy Lake were sent to resource professionals at the Michigan Natural Features Inventory and positively identified as *Eurasian Watermilfoil.* This was the first confirmed discovery of the *Eurasian Watermilfoil* in Dickinson County, however, through December of 2002, four total lakes have been found to be infested with this nuisance species and two other infestations are suspected.

Purple loosestrife is the showy spike shaped flower that grows along roadsides in ditches and at the margins of many lakes, streams, and wetlands. This garden landscaping plant has spread throughout much of the United States, replacing native food and cover plants that wildlife depend on for survival. There are small patches along the banks of White Creek from Holy Spirit School to the Norway Wastewater Treatment Plant. The plant could spread along the creek side for an additional 1.75 miles and enter the Menominee River from this source.

The Zebra Mussel (*Dreissena polymorpha*) was found in Fortune Pond of Iron County and in Lake Antoine of Dickinson County in October 2001. These were the first inland lakes in Michigan's Upper Peninsula to be invaded by zebra mussels. Currently, there are no waterbodies in the Fumee Creek Watershed where zebra mussels are present. Due to the proximity of Lake Antoine to the northern boarder of the Fumee Creek Watershed and the fact that Lake Antoine is a heavily used recreation lake there is reason to be concerned for the spread of this species. (Lake Antoine is a heavily used recreation lake and is located just north of the Fumee Creek Watershed boundary. There is concern about future invasions of zebra mussels because the primary method of spread is by the mussels attaching themselves to hard surfaces (i.e. watercraft, trailers, and swimming and scuba equipment) and moving with the object to another waterbody.)

There are over 140 non-native aquatic species in the Great Lakes Basin. Introduction began in the early 1800s resulting primarily from the shipping industry and accidental releases from aquaculture, bait, aquarium trade, and horticultural activities (Biological Invasions Pamphlet). Since the opening of the St. Lawrence Seaway 35 years ago, larger vessels from all over the world have been capable of entering the Great Lakes Basin and have brought with them over one-third of the total introduced aquatic species (Biological Invasions Pamphlet). Other well known aquatic nuisance species in the Great Lakes Region include the Sea Lamprey, Round Goby, Rusty Crayfish, and Ruffe.

Bacteria & Pathogens

Bacteria occur naturally in the environment and the majority of them are not harmful to humans. Fecal coliform bacteria and total bacteria are the most common forms monitored for in water quality investigations to determine the suitability of the water for the drinking and human contact designated uses (Ch. 10 Water Quality). When bacteria is present in high concentrations they may indicate the presence of pathogenic organisms like harmful bacteria, viruses, and parasites that cause disease and illness (Field Manual-WQ Monitoring).

Fecal coliform is found in the feces of humans and other warm-blooded mammals (Field Manual-WQ Monitoring). Wastewater treatment plant sanitary sewer overflows (sewage only) or combined sewer overflows (stormwater and sewage) are point sources of bacteria in surface water. Heavy rains may create a situation where the treatment plant can not process and treat the water to its fullest capacity and therefore must directly discharge the excess water to the receiving watercourse (DEQ-Bacteria). Runoff during rain events in areas of livestock operations, urban stormwater, illicit wastewater discharges to stormwater sewers, pet wastes, and failing septic systems are the most common nonpoint sources of fecal coliform bacteria pollution in a watershed. The DEQ standard for waterbodies protected for the partial body contact recreation designated use is 1000 *E. coli* per 100 ml of water (DEQ-Bacteria).

Discharges containing treated or untreated human wastes; such as from wastewater treatment plants, have separate standards and are covered by National Pollution Discharge Elimination System (NPDES) permits. This situation may occur at a wastewater treatment plant during times that heavy rainfall exceeds the capacity of the plant to treat all the incoming water and results in the discharge of untreated waste into a natural body of water. The Michigan Department of Environmental Quality has the authority to set pollution thresholds for infectious organisms not included in Rule 62 on a case-by-case basis to ensure that the designated uses are protected (DEQ-Bacteria).

Michigan Water Quality Standards Part 4 Rule 62 of Part 31, Water Resources Protection, of Act 451 of 1994 limits the concentration of microorganisms in surface waters of the state. Waters of the state protected for the total body contact recreation designated use may not exceed more than 130 *Escherichia coli* (E. coli) per 100 milliliters (ml) of water as a 30-day average and 300 fecal coliform bacteria per 100 ml of water at any time. The limit for waters of the state

8) **Oil, Grease, and Metals**

Plants and animals require trace amounts of some essential metals for growth and maintenance, but large amounts of these metals and other unnecessary metals (i.e., mercury) may become toxic (Ecology Book/www.geocities.com). Natural sources of metals include volcanic eruptions and the weathering of different geologic layers. Geologic layers like sandstone, granite, limestone, and basalt will have varying amounts of heavy metal concentrations (Ch. 10-Water Quality). Metals, like nutrients, are attracted to sediment particles by opposite charge. Watershed management goals must attempt to reduce the impact of land use practices that produce increased erosion and sedimentation (Ch. 10 Water Quality).

The primary point sources of metals in surface waters are sewage discharges and some industrial discharges. Nonpoint sources of oil, grease, and metals in the Fumee Creek Watershed come from untreated stormwater discharges to lakes and streams. These materials collect on roads and parking lots year round and are transported to lakes and streams by storm sewers carrying runoff from urban areas. Oils, grease, and metal nonpoint source pollutants have been visually confirmed in the Fumee Creek Watershed through oil sheens near storm sewer discharges and through the location of developments like car service stations next to storm drains.

9) **Debris & Litter**

Urban watersheds have a never ending problem with debris and litter pollution. The degree and severity to which this source of pollution occurs can vary by watershed. In general, more trash is produced in places where there is a larger concentration of people.

Even if the residents of a city are aware that littering is a problem and take care that it does not occur, there are still more dumpsters and trash cans where an accidental spill may take place.

Direct stormwater discharges to lakes and streams increases the possibility of litter and debris pollution. The volume of water increases and drains faster to a waterbody when connected to a storm sewer network. There is also a greater land area that contributes water in each storm event. All of these characteristics increase the possibility of bringing more debris and litter to the surface waters of an urban watershed.

One of the important aspects in a watershed is the perception that residents have of the lakes and streams in their community. Those held in high regard receive more attention and are less likely to receive litter inputs. Four-five volunteers participated in two Fumee Creek Watershed Two Fumee Creek Watershed stream cleanups on White Creek in 2002 alone resulted in over 20 bags of garbage and several other larger objects being removed from 1 ¼ miles of stream impacted by stormwater and riparian development.

Direct impacts such as death or disease of aquatic organisms is typically not the result of debris and litter pollution. There is a possibility that a fish, turtle, frog, or other organism may become entrapped or entangled by various objects that reach a waterbody. Michigan Water Quality Standard Part 4 Rule 50 of Part 31, Water Resources Protection, of Act 451 of 1994 sets a "narrative standard" that relates to litter and debris pollution. The Standard says "waters of the state shall not have any of the following unnatural physical properties in quantities which are or may become injurious to any designated use: turbidity, color, oil films, floating solids, foam, settleable solids, suspended solids, and deposits."

Summary of Watershed Inventory Methods

A. Visual Inventory

The most useful method of inventorying the Fumee Creek Watershed was through visual means. Nearly all of the stream and river miles and lakeshore have been visually inventoried by wading, walking, kayak, and automobile. Specific Best Management Practice site locations and certain portions of the watershed critical area were identified in the visual inventory process. The visual inventory was also useful in selecting locations to perform the other watershed inventory methods such as the aquatic macroinvertebrate sampling, water quality testing and the temperature logger placement. The following is a list of sites where pollutant inputs were known or suspected following the Visual Inventory of the Watershed.

Figure 16: Results of the Visual Inventory

Site	Township	Location	Pollutants
White Creek Channel	Norway Twp.	T39N, R29W, Section 8	S,N,H,D,T
White Creek Stormwater Input	Norway Twp.	T39N, R29W, Section 8	S,N,H,D,T,P,L,O
Aragon Mine Shaft Groundwater Pump	Norway Twp.	T39N, R29W, Section 8	S,H,
White Creek Banks	Norway Twp.	T39N, R29W, Section 8	S,N,T,H,D
Fumee Creek below Gunville Trucking	Breitung Twp.	T39N, R30W, Sections 2 & 3	S,N
White Creek Purple Loose Strife	Norway Twp.	T39N, R29W, Section 17	E,S
White Creek Residental Area	Norway Twp.	T39N, R29W, Section 8	S,N
Gunville Trucking Slope	Breitung Twp.	T39N, R30W, Sections 2 & 3	S,N,H,O
U.S. 2 Terraced Land	City of Ir. Mt	T40N, R30W, Section 32	S,N,H
Dickinson Co. Healthcare System	City of Ir. Mt	T40N, R30W, Section 32	S,N,H,O,D,T
Lofholm's Building Supply	City of Norway	T39N, R29W, Section 8	S,N,H,O,D,T
Bob's Homes & Wally's Auto Salvage	Breitung Twp.	T40N, R30W, Section 32	S,N,H,O,D,T
BP Gas Station	City of Norway	T39N, R29W, Section 8	S,N,H,O,D,T
NE Quad. Breitung Road & Poor Farm Creek	Breitung Twp.	T39N, R30W, Section 4	S,N,H
U.S. 2 & Quinnesec Fumee Creek	Norway Twp.	T39N, R29W, Section 22	S,N,H,O
Lake Mary Stormwater Outlet at School	City of Norway	T39N, R29W, Section 9	S,N,H,T,B,P,O,D
Timberlane Subdivision Expansion	Breitung Twp.	T40N, R30W, Section 27	S,N,H
NW Quad. Breitung Road & Poor Farm Creek	Breitung Twp.	T39N, R30W, Section 4	S,N,H
Lake Mary Stormwater Runoff	City of Norway	T39N, R29W, Section 9	S,N,H,T,B,P,O,D
Fumee Creek & Private Drive Road Crossing	Breitung Twp.	T40N, R23W, Section 35	S,N,H
Pellegrini Farm Creek Crossing	Norway Twp.	T39N, R29W, Section 22	S,N,H
SW Quad. Hwy 141 & Breitung Road -- North & South Poor Farm Creek Crossing	Norway Twp.	T39N, R30W, Section 4	S,N,H

Pier's Gorge Road Crossing	Norway Twp.	T39N, R29W, Section 19	S,N,H
Kimberly Road & White Creek Crossing	Norway Twp.	T39N, R29W, Section 8	S,N,H
Timberlane Subdivision Gravel Road	Breitung Twp.	T40N, R30W, Section 27	S,N,H
Holy Spirit School Driveway & White Creek Crossing	City of Norway	T39N, R29W, Section 8	S,N,H
Forest Road & White Creek Crossing	Norway Twp.	T39N, R29W, Section 16	S,N,H
Fox Ranch Drive & Fumee Creek Crossing	Norway Twp.	T39N, R29W, Section 22	S,N,H
Kingsford Stormwater Release	City of Kingsford	T39N, R31W, Section 11 & 12	S,N,H,T,B,P,O,D
Fumee Falls Roadside Park	Breitung Twp.	T39N, R30W, Section 2	S,N,O
Gunville Fumee Creek ORV Crossing	Breitung Twp.	T39N, R30W, Section 2	S,N,
Highway 8 White Creek Pedestrian Bridge	Norway Twp.	T39N, R29W, Section 8 & 17	S,N,H
South Breitung Road Ditch	Breitung Twp.	T39N, R30W, Section 4	S,N
Maple Leaf Kennel Driveway	Breitung Twp.	T39N, R30W, Section 4	SN,H
North Breitung Road Ditch	Breitung Twp.	T39N, R30W, Section 4	S,N,H
Pollard's/White Creek	City of Norway	T39N, R29W, Section 8	S,N,D,B,P,O
Cowboy Lake & Menominee River	City of Kingsford	T39N, R29W, Section 33 & 34	S,N,E,B,O,P
Menominee River Recreation Area Riverbank	City of Kingsford	T39N, R31W, Section 11	S,N
Holy Spirit - Norway Streambanks	City of Norway	T39N, R29W, Section 8	S,N
NE Quad. Streambank of Breitung Road & Poor Farm Creek	Breitung Twp.	T39N, R30W, Section 4	S,N
Norway Waste Water Treatment Plant Streambanks	Norway Twp.	T39N, R39W, Section 17	S,N
SW Quad. Streambank of Pedestrian Bridge & White Creek	City of Norway	T39N, R29W, Section 8	S,N
SW Quad. Streambank on Hwy 8 & White Creek	City of Norway	T39N, R29W, Section 8	S,N
SW Streambank of Kimberly Road & White Creek	City of Norway	T39N, R29W, Section 8	S,N
Timberlane Subdivision Creek	Breitung Twp.	T40N, R30W, Section 27	S,N
Dickinson Co. Fairgrounds	Norway Twp.	T39N, R29W, Section 16 & 17	N,D,B,P
Daegner Farm	Norway Twp.	T39N, R29W, Section 21 & 22	N,D,B,P
Oak Crest Stables	Norway Twp.	T39N, R29W, Section 17	N,D,B,P

B. Water Quality Monitoring

Aquatic Macroinvertebrate Sampling (Biological Parameter)

Macroinvertebrate sampling was conducted in the Fumee Creek Watershed using the Environmental Protection Agency's Rapid Bioassessment Protocol III (RBP III). The RBP III is capable of providing data to be used for prioritizing sites for more intensive investigation. Data collected by Fumee Creek Watershed volunteers and project manager will be used as baseline data to allow the possibility of monitoring any future trends or changes in the macroinvertebrate community. Water quality monitoring was guided by a DEQ approved Quality Assurance Performance Plan (QAPP). (See Appendix J) Sites monitored are detailed on Figure 17 below.

The protocol focuses on the most productive habitats, riffles and runs, to obtain a representative sample that can be compared to the regional high quality control site and sites within the watershed. This method of macroinvertebrate sampling required the collection of 100 organisms from the scraper and filtering collector groups of aquatic insects with a kick net from two 1 m^2 sections of riffle habitat. Run habitats with rock substrate were sampled if suitable riffle habitats were not available. If riffles and runs were not suitable, the methods of sampling relied on hand picking macroinvertebrates from available hard surfaces or sampling all available habitats. A supplemental sample was drawn from available Course Particulate Organic Matter to provide data on the community of shredders at each site.

Figure 17. Fumee Creek Watershed Benthic Sampling Sites Narrative

Site Code	Waterbody Name	Location
FCWS-1	Fumee Creek	Downstream of Fumee and Little Fumee Lake outlet convergence in Fumee Natural Area
FCWS-2	Fumee Creek	Upstream of Kimberly Road and approximately 150 feet downstream of railroad tracks
FCWS-3	White Creek	Just south of the LaFaive Oil Co. office building by McDonald's
FCWS-4	White Creek	Approximately 100 feet upstream of Kimberly Road
FCWS-5	White Creek	Approximately 200 feet upstream of WPA

		Road
FCWS-6	Poor Farm Creek	Downstream of south Hwy ditch discharge and approximately 30-50 feet downstream of U.S. 2
FCWS-7	Poor Farm Creek	350 feet downstream of the pond at the corner of Hwy 141 and Breitung Road
FCWS-8	Jones Creek	Just north of the Breitung Road Culvert
FCWS-9	LaFaive Creek	Upstream approximately 30 feet
FCWS-10	Rocconi Creek	Approximately 100 feet upstream of the trail bridge
FCWS-11	Strawberry Creek	Approximately 50 feet upstream of Strawberry Lake
FCWS-12	Timberlane Creek	Approximately 50 feet upstream of the road culvert

Benthic Macroinvertebrate data for use in the Fumee Creek Watershed Management Plan includes information on relative abundance of species, species diversity, and a comparison of the number of pollution intolerant species versus pollution tolerant species. Raw benthic data and the list of sampling stations is included in Appendix F.

Habitat Assessment

Another type of EPA Rapid Bioassessment Protocol involves classifying the stream habitat. This matrix measures parameters of the stream that would have the most affect on biological life and is used to verify the results of the benthic macroinvertebrate study above. Parameters include bottom substrate, embeddedness (amount of sand covering the gravel and cobbles), stream flow, channel alteration (degree to which deposited material form islands or chether channelization has taken place), bottom scouring and deposition, pool/rifle and run/bend ratio, bank stability, bank vegetative stability, and streamside cover. A total score is given to each test station (same stations as for the Benthic Macroinvertebrates), which is then classified on the basis of its similarity to the reference station (known to be of high quality and supporting a wide range of biological life) and its ability to support biological health.

Habitat Assessment Data is included in Appendix E. Of the twelve stations sampled, only one station (Fumee Creek upstream of Kimberly Road) had high quality habitat comparable to the reference site on Pine Creek. Two sites, Fumee Creek near the Natural

Area and LaFaive Creek near Pier's Gorge, ranked as capable of supporting biological health. Timberlane Creek ranked as partially capable of supporting biologic health and all the rest of the sites (White Creek, Poor Farm Creek, Jones Creek, Rocconi Creek and Strawberry Creek) ranked as not capable of supporting biologic health.

Analysis of Chemical and Physical Parameters

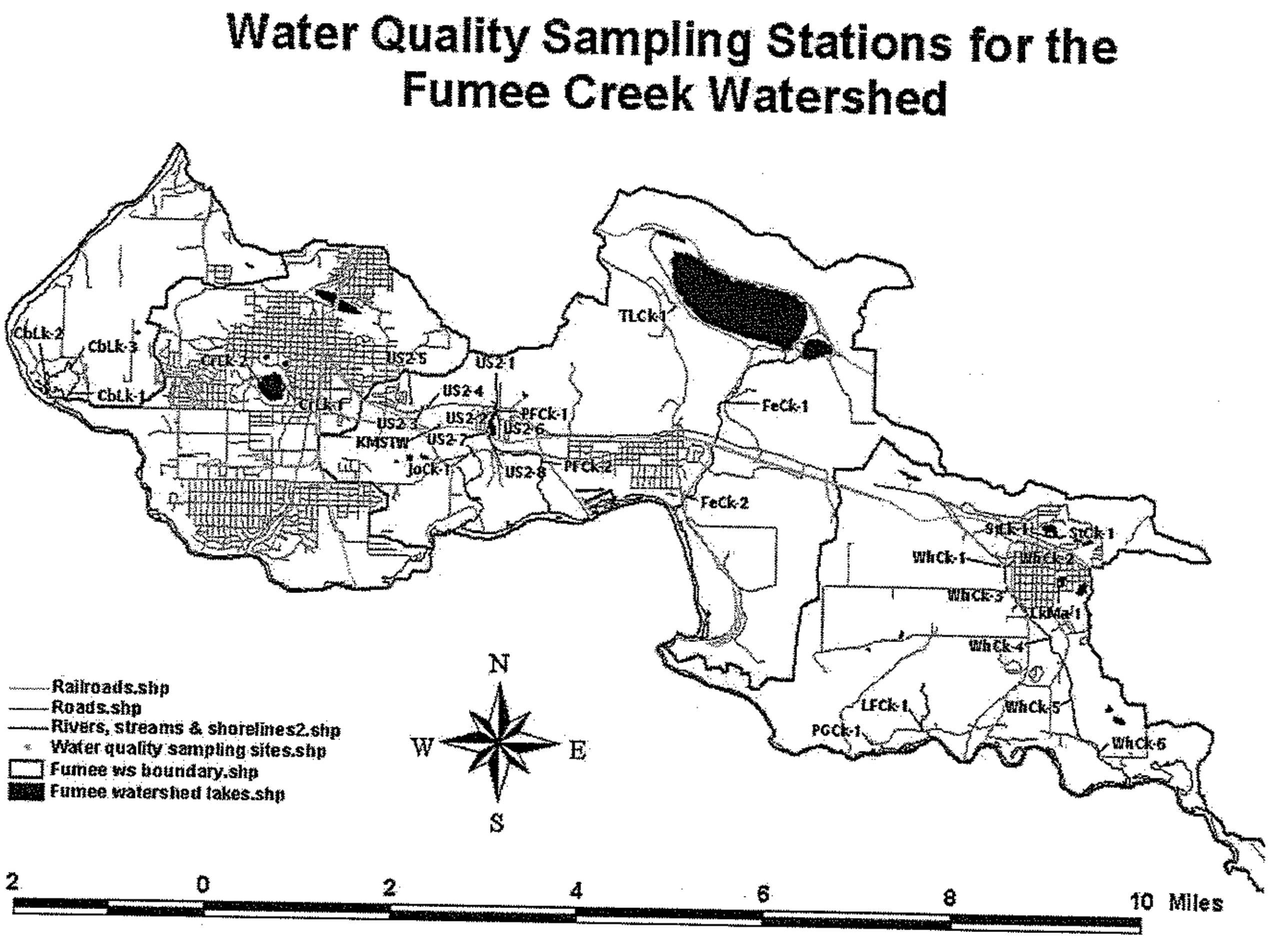
Water quality analysis was chosen as a watershed inventory method to provide baseline data to be used in future investigations in the watershed. The results were used only for educational purposes and to indicate possible areas of concern. Approximately 20 sites were selected for regular water sample collection (Figure 17.)

Other collection sites associated with areas of concern were chosen to determine the presence or absence of possible watershed pollutants. Several chemical and physical water quality parameters were tested. Chemical water quality parameters included ammonia nitrogen, nitrate nitrogen, phosphate, calcium hardness, and magnesium hardness. Temperature, dissolved oxygen, biochemical oxygen demand, conductivity, total hardness, turbidity, and stage height comprises the major physical water quality parameters collected.

Grab samples were collected in the field and brought back to the Dickinson Conservation District for some of the chemical and physical analyses. Other physical parameters were collected and recorded on data sheets on site in the field. See Appendix J for test kits and equipment that was used to perform the water quality tests.

In an effort to maintain accuracy, duplicate tests were run on samples in each collection date. The results of all the duplicates remained extremely close to the original results and were therefore not included in the data sheet included in the Fumee Creek Watershed Management Plan. Duplicate samples were also sent to a professional water quality analysis laboratory to obtain more precise chemical and physical results to further determine the accuracy of the test kits used at the Dickinson Conservation District. The environmental firm, White Water and Associates out of Amasa, MI, performed the more detailed analysis. Samples were also sent to this firm to test heavy metal concentration in bottom sediments of Crystal Lake; salinity, total phosphate, nitrate nitrogen, and total suspended solids; and urban stormwater samples along the U.S. 2 corridor to test for dissolved heavy metals and volatile organic compounds. Baseline Water Quality Data is displayed below. (Figure 18)

Figure 18. Water Quality Sampling Stations for Fumee Creek Watershed (Chemical and Physical Parameters)



Complete data recorded for 32 sampling stations is included in its raw form in Figure 19. While primarily educational and a means of flagging "hot" spots, this data will remain to serve as local baseline data on the watershed.

Figure 19

Updated for the FCWS Management Plan 5/16/02. **Fumee Creek Watershed Project water quality results through July 1, 2001.**

[ ] Equals a water quality flag.

Equals a possible water quality concern or shift in test results.

	Date	Temp. °C	Temp. °F	DO mg/L	DO Sat. mg/L	DO Defct. mg/L	BOD mg/L	Ammonia ppm	Nitrate ppm	Phosphate ppm	pH	Conductivity um	Total Hardness	Calcium Hardness	Magnesium Hardness	Turbidity cm	Stage meters
1) Crystal Lk. Inlet	11/14/00	5.2	41.36	10.88	12.72	1.84	4.33	0.25	0	0	5.5	N/A	N/A	N/A	N/A	N/A	N/A
1) Crystal Lk. Inlet	4/12/01	1.5	34.7	9.1	14.05	4.95	1.77	0.325	0	0	8.6	46	24	16	8	39	1.56
1) Crystal Lk. Inlet	5/30/01	16.5	61.7	8.21	9.71	1.50	2.27	<0.13	0	0	7.53	748	128	72	56	60	1.59
1) Crystal Lk. Inlet	6/27/01	27.3	81.14	9.7	7.83	-1.87	N/A	<0.13	0	0	8.59	551	96	48	48	60	1.49
1) Crystal Lk. Inlet	6/11/02	23.1	73.58	8.79	8.48	-0.31	2	<0.13	0	0.1	8.64	660	N/A	N/A	N/A	60	1.52
1) White Water Results	**6/11/02**								ND	Total P-0.07							
2) Crystal Lk. Med. Park	11/14/00	4.8	40.64	9.7	12.86	3.16	2.52	0.1	0	0	6	N/A	N/A	N/A	N/A	N/A	N/A
2) Crystal Lk. Med. Park	4/12/01	2.6	36.68	10.18	13.64	3.46	5.94	0.13	0	0	8.5	116	52	20	32	60	N/A
2) Crystal Lk. Med. Park	5/30/01	16.8	62.24	10.04	9.65	-0.39	2.84	<0.13	0	0	7.68	713	124	68	56	60	N/A
2) Crystal Lk. Med. Park	6/27/01	23.3	73.94	8.23	8.45	0.22	N/A	<0.13	0	0	7.99	509	112	48	64	60	N/A
2) Crystal Lk. Med. Park	6/11/02	23.6	74.48	9.02	8.40	-0.62	4.17	<0.13	0	0	8.6	660	N/A	N/A	N/A	60	N/A
3) Poor Farm Ck. HW	11/22/00	5.3	41.54	10.1	12.69	2.59	1.37	0.13	0	0	7	521	N/A	N/A	N/A	N/A	N/A
3) Poor Farm Ck. HW	4/12/01	6.3	43.34	10.84	12.37	1.53	2.32	0.325	0	0.1	7.45	487	232	152	80	60	1.09
3) Poor Farm Ck. HW	5/30/01	8.8	47.84	8.78	11.61	2.83	1.65	<0.13	0	0	7.44	564	276	160	116	60	1.11
3) Poor Farm Ck. HW	6/27/01	12.6	54.68	7.9	10.60	2.70	N/A	<0.13	0	0.1	7.67	477	268	144	124	60	1.11
3) Poor Farm Ck. HW	6/11/02	14.2	57.56	8.42	10.22	1.80	1.31	<0.13	0	0.1	8.57	430	N/A	N/A	N/A	60	1.15
4) Poor Farm Ck. Mouth	11/22/00	1.2	34.16	12.8	14.17	1.37	2.12	0.13	4.4	0	7	489	N/A	N/A	N/A	N/A	N/A
4) Poor Farm Ck. Mouth	4/12/01	6.6	43.88	11.73	12.27	0.54	2.18	0.325	0	0	7.94	510	204	108	96	60	0.33
4) Poor Farm Ck. Mouth	5/30/01	12.2	53.96	10.98	10.70	-0.28	2.33	<0.13	0	0	7.86	610	244	224	20	60	0.38
4) Poor Farm Ck. Mouth	6/27/01	21.8	71.24	8.56	8.70	0.14	N/A	<0.13	0	0	8.11	519	240	120	120	60	0.39
4) Poor Farm Ck. Mouth	6/11/02	17.5	63.5	8.63	9.50	0.87	1.62	<0.13	4.4	0.1	8.5	490	N/A	N/A	N/A	60	0.34
5) Jones Ck. HW	11/22/00	1.9	35.42	11.95	13.90	1.95	2.09	0.325	8.8	0	7	1057	N/A	N/A	N/A	N/A	N/A
5) Jones Ck. HW	4/12/01	8.2	46.76	10.44	11.78	1.34	2.15	0.13	2.2	0	7.87	1264	340	224	116	60	0.1
5) Jones Ck. HW	5/30/01	11.7	53.06	9.82	10.82	1.00	1.5	0.13	0	0	7.85	1334	424	256	168	60	0.1
5) Jones Ck. HW	6/27/01	19.2	66.56	8.05	9.17	1.12	N/A	<0.13	4.4	0	8.03	1113	428	204	224	60	0.1
5) Jones Ck. HW	6/11/02	16.5	61.7	8.15	9.71	1.56	1.48	<0.13	2.2	0.1	8.19	1030	N/A	N/A	N/A	60	0.09
6) TimberLane Ck.	11/22/00	0.3	32.54	13.35	14.53	1.18	3.42	0.325	0	0	6	438	N/A	N/A	N/A	N/A	N/A
6) TimberLane Ck.	4/12/01	3.5	38.3	12.15	13.31	1.16	3.09	0.13	0	0	7.76	290	140	76	64	60	N/A
6) TimberLane Ck.	5/31/01	10.5	50.9	9.45	11.14	1.69	1.1	<0.13	0	0	7.86	541	256	140	116	60	N/A
6) TimberLane Ck.	6/28/01	16.3	61.34	8.66	9.75	1.09	N/A	<0.13	0	0	7.89	541	304	168	136	60	N/A
6) TimberLane Ck.	6/11/02	16.3	61.34	8.75	9.75	1.00	1.17	<0.13	0	0	8.64	290	N/A	N/A	N/A	60	N/A
	Date	Temp. °C	Temp. °F	DO mg/L	DO Sat. mg/L	DO Defct. mg/L	BOD mg/L	Ammonia ppm	Nitrate ppm	Phosphate ppm	pH	Conductivity um	Total Hardness	Calcium Hardness	Magnesium Hardness	Turbidity cm	Stage meters
7) Fumee Ck. HW	11/22/00	1.2	34.16	12.51	14.17	1.66	3.09	0.13	0	0	6	279	N/A	N/A	N/A	N/A	N/A
7) Fumee Ck. HW	4/12/01	5.2	41.36	11.28	12.72	1.44	2.85	0.325	0	0	7.7	255	124	76	48	60	1.06
7) Fumee Ck. HW	5/31/01	11.3	52.34	9.41	10.92	1.51	1.25	<0.13	0	0	7.84	334	184	84	100	60	1.15
7) Fumee Ck. HW	6/28/01	21	69.8	7.4	8.84	1.44	N/A	<0.13	0	0	7.82	297	192	96	96	60	1.1
7) Fumee Ck. HW	6/11/02	19	66.2	7.28	9.21	1.93	1.18	<0.13	0	0	8.69	290	N/A	N/A	N/A	60	?770.62
8) Fumee Ck. Mouth	11/22/00	0.8	33.44	12.87	14.33	1.46	2.92	0.325	0	0	7	349	N/A	N/A	N/A	N/A	N/A
8) Fumee Ck. Mouth	4/12/01	5.3	41.54	11.72	12.69	0.97	3.03	0.325	0	0	7.99	290	144	84	60	60	2.15
8) Fumee Ck. Mouth	5/31/01	9.4	48.92	10.14	11.44	1.30	2.25	<0.13	0	0	7.88	345	200	104	96	60	2.25

Site	Date	Temp. °C	Temp. °F	DO mg/L	DO Sat. mg/L	DO Defct. mg/L	BOD mg/L	Ammonia ppm	Nitrate ppm	Phosphate ppm	pH	Conductivity um	Total Hardness	Calcium Hardness	Magnesium Hardness	Turbidity cm	Stage meters
8) Fumee Ck. Mouth	6/28/01	18.3	64.94	8	9.34	1.34	N/A	<0.13	0	0	7.93	329	180	108	72	60	2.22
8) Fumee Ck. Mouth	6/11/02	18.3	64.94	8.3	9.34	1.04	1.42	<0.13	0	0	8.73	320	N/A	N/A	N/A	60	2.12
9) White Ck. @ Amoco	11/22/00	0.2	32.36	12.27	14.57	2.30	2.04	0.325	8.8	0	6	415	N/A	N/A	N/A	N/A	N/A
9) White Ck. @ Amoco	4/12/01	4.7	40.46	10.12	12.89	2.77	3.59	0.13	4.4	0	7.34	302	180	108	72	60	0.9
9) White Ck. @ Amoco	5/30/01	12.3	54.14	10.35	10.67	0.32	1.8	<0.13	26.4	0	7.83	483	240	120	120	60	1
9) White Water Results	5/30/01	**Chloride - 16 mg/L (ppm)**							2.6	0.01							
9) White Ck. @ Amoco	6/27/01	21.3	70.34	7.95	8.79	0.84	N/A	<0.13	13.2	0	8.01	403	244	140	104	60	1.03
9) White Water Results	6/27/01	Before Rain							3.7	0.02							
9) White Ck. @ Amoco	6/11/02	17.2	62.96	8.75	9.56	0.81	1.05	<0.13	8.8	0	8.7	390	N/A	N/A	N/A	60	0.98
10-A) White Ck. @ U.S. 2	11/22/00	8.8	47.84	9.9	11.61	1.71	0.5	0.325	8.8	0	6.5	492	N/A	N/A	N/A	N/A	N/A
10-A) White Ck. @ U.S. 2	4/12/01	9.5	49.1	10.3	11.41	1.11	3.45	<0.13	8.8	0	7.74	545	260	180	80	25	0.88
10-A) White Ck. @ U.S. 2	5/30/01	10.2	50.36	1.22	11.22	10.00	0.06	<0.13	0	0.1	7.85	851	380	212	168	60	0.87
10-A) White Water Results	5/30/01	**Chloride - 46 mg/L (ppm)**							1.1	0.23					**After Rain--**	27	
10-A) White Ck. @ U.S. 2	6/27/01	15.4	59.72	7.96	9.95	1.99	N/A	<0.13	0	0	7.87	466	248	124	124	60	0.95
10-A) White Water Results	6/27/01	**Before Rain**							0.6	0.02				Total Suspended Solids		ND	
10-A) White Water Results	6/27/01	**After Rain**							1.4	0.15				Total Suspended Solids		332 mg/L	
10-A) White Ck. @ U.S. 2	6/11/02	14.9	58.82	8.07	10.06	1.99	6.31	<0.13	4.4	0	8.64	460	N/A	N/A	N/A	60	0.95
10-A) White Water Results	6/11/02								1.6	ND							
10-B) White Ck. @ Kimberly	11/22/00	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-B) White Ck. @ Kimberly	4/12/01	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-B) White Ck. @ Kimberly	5/30/01	12.4	54.32	4.59	10.65	6.06	0.5	<0.13	8.8	0.1	7.88	771	358	168	190	60	0.35
10-B) White Water Results	5/30/01	**Chloride - 46 mg/L (ppm)**							1.4	0.02							
10-B) White Ck. @ Kimberly	6/27/01	21.3	70.34	7.95	8.79	0.84	N/A	<0.13	13.2	0	7.99	403	266	148	118	60	0.48
10-B) White Water Results	6/27/01	After Rain			**Chloride - 16 mg/L (ppm)**				3.8	0.01							
10-B) White Ck. @ Kimberly	6/11/02	18.8	65.84	9.66	9.25	-0.41	2.13	<0.13	8.8	0	8.76	400	N/A	N/A	N/A	60	0.45
10-C) White Ck. D/S WWTP	6/27/01	**White Water Results after rain event**					Chloride - 48 mg/L		8.4	0.16							
10-C) White Ck. D/S WWTP	6/11/02	17	62.6	7.7	9.61	1.91	1.7	<0.13	28.4	0.3	8.43	520	N/A	N/A	N/A	60	N/A
10-D) White Ck. U/S Cem. Rd.	6/11/02	16.2	61.16	9.77	9.77	0.00	2.37	<0.13	17.6	0.3	8.61	620	N/A	N/A	N/A	60	1.3
11) White Ck. @ WPA Rd.	11/22/00	4.4	39.92	11.76	13.00	1.24	2.11	0.13	17.6	0.1	6.5	657	N/A	N/A	N/A	N/A	N/A
11) White Ck. @ WPA Rd.	4/12/01	6.7	44.06	10.53	12.24	1.71	1.88	0.325	8.8	0	7.84	418	176	116	60	60	0.7
11) White Ck. @ WPA Rd.	5/30/01	14.6	58.28	9.5	10.12	0.62	3.63	<0.13	17.6	0.5	7.8	736	328	196	132	26	0.75
11) White Ck. @ WPA Rd.	6/27/01	17.1	62.78	8.65	9.58	0.93	N/A	<0.13	13.2	0.2	8.05	625	320	180	140	60	0.71
11) White Water Results	6/27/01	Before Rain							4.7	0.08							
11) White Ck. @ WPA Rd.	6/11/02	16.5	61.7	9.4	9.71	0.31	1.55	<0.13	8.8	0.2	8.59	590	N/A	N/A	N/A	60	0.68
12) LaFaive Ck (1st one)	11/22/00	0.9	33.62	13.15	14.29	1.14	2.8	0.325	0	0	6.5	217	N/A	N/A	N/A	N/A	N/A
12) LaFaive Ck (1st one)	4/12/01	4.1	39.38	12.35	13.10	0.75	2.98	<0.13	0	0	7.95	209	120	68	52	60	0.77
12) LaFaive Ck (1st one)	5/30/01	13.4	56.12	9.9	10.40	0.50	1.06	<0.13	0	0	7.58	230	128	68	60	60	N/A
12) LaFaive Ck (1st one)	6/27/01	18.1	64.58	8.6	9.38	0.78	N/A	<0.13	0	0	7.82	223	140	80	60	60	0.68
12) LaFaive Ck (1st one)	6/11/02	**No Sample Taken**											N/A	N/A	N/A		
13) Rocconi Ck. (2nd one)	11/22/00	4.9	40.82	9.52	12.82	3.30	0.89	0.13	0	0	7	631	N/A	N/A	N/A	N/A	N/A
13) Rocconi Ck. (2nd one)	4/12/01	4.9	40.82	10.86	12.82	1.96	2.62	<0.13	0	0	7.56	626	300	220	80	60	0.83
13) Rocconi Ck. (2nd one)	5/30/01	8.8	47.84	8.86	11.61	2.75	0.72	<0.13	0	0	7.78	736	356	196	160	60	0.84
13) Rocconi Ck. (2nd one)	6/27/01	11.5	52.7	7.94	10.87	2.93	N/A	<0.13	0	0	7.78	583	340	180	160	60	0.83

13) Rocconi Ck. (2nd one)	6/11/02	No Sample Taken											N/A	N/A	N/A		
14) Lake Mary (across)	None	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14) Lake Mary (across)	4/12/01	3.3	37.94	10.6	13.38	2.78	3.75	0.13	0	0	7.3	35	48	16	32	60	N/A
14) Lake Mary (across)	5/30/01	20.7	69.26	9.98	8.89	-1.09	3.48	<0.13	0	0	7.13	380	76	36	40	60	N/A
14) Lake Mary (across)	6/27/01	26.6	79.88	8.34	7.93	-0.41	N/A	<0.13	0	0	7.6	350	92	40	52	60	N/A
14) Lake Mary (across)	6/11/02	24.8	76.64	7.73	8.21	0.48	2.74	<0.13	0	0	8.14	450	N/A	N/A	N/A	60	N/A
16) Strawberry Lk.	11/22/00	3.1	37.58	7.5	13.45	5.95	2.21	0.65	0	0	7	652	N/A	N/A	N/A	N/A	N/A
16) Strawberry Lk.	4/12/01	3.1	37.58	11.7	13.45	1.75	4.09	0.13	0	0	7.74	209	84	52	32	60	N/A
16) Strawberry Lk.	5/30/01	20.6	69.08	10.35	8.91	-1.44	1.74	<0.13	0	0.1	7.9	725	284	132	152	60	N/A
16) Strawberry Lk.	6/27/01	26.5	79.7	10.15	7.95	-2.20	N/A	<0.13	0	0	8.25	519	240	88	152	60	N/A
16) Strawberry Lk.	6/11/02	24.7	76.46	10.84	8.22	-2.62	1.94	<0.13	0	0.1	8.67	620	N/A	N/A	N/A	60	N/A
17) Strawberry Ck.	11/22/00	0.1	32.18	11.9	14.61	2.71	1.45	0.325	0	0	7	571	N/A	N/A	N/A	N/A	N/A
17) Strawberry Ck.	4/12/01	2.6	36.68	11.9	13.64	1.74	5.49	0.13	0	0.2	7.85	476	228	140	88	21	N/A
17) Strawberry Ck.	5/30/01	13.4	56.12	9.32	10.40	1.08	0.97	<0.13	0	0.1	7.88	621	336	140	196	60	N/A
17) Strawberry Ck.	6/27/01	21.6	70.88	6.79	8.74	1.95	N/A	<0.13	0	0.3	7.93	488	296	136	160	31	N/A
17) Strawberry Ck.	6/11/02	21.5	70.7	7.04	8.75	1.71	1.79	<0.13	0	0.2	8.52	560	N/A	N/A	N/A	60	2.41
	Date	Temp. °C	Temp. °F	DO mg/L	DO Sat. mg/L	DO Defct. mg/L	BOD mg/L	Ammonia ppm	Nitrate ppm	Phosphate ppm	pH	Conductivity um	Total Hardness	Calcium Hardness	Magnesium Hardness	Turbidity cm	Stage meters
18) Cowboy Lk. Boat Dock	10/27/01	11.4	52.52	9.85	10.90	1.05	4.38	<0.13	0	N/A	8.25	N/A	N/A	N/A	N/A	60	N/A
18) Cowboy Lk. Boat Dock	4/13/01	0.3	32.54	11.2	14.53	3.33	4.49	0.13	0	0	6.73	58	72	20	52	60	0.36
18) Cowboy Lk. Boat Dock	5/31/01	20.5	68.9	9.4	8.93	-0.47	2.15	<0.13	0	0	7.63	138	100	48	52	60	0.17
18) Cowboy Lk. Boat Dock	6/28/01	27	80.6	7.63	7.87	0.24	N/A	<0.13	0	0	7.5	138	84	48	36	60	0.09
18) Cowboy Lk. Boat Dock	6/11/02	25.3	77.54	9.33	8.13	-1.20	2.38	<0.13	0	0.1	9.06	120	N/A	N/A	N/A	60	0.06
19) Cowboy Lk. Channel	10/27/00	14.5	58.1	9.28	10.15	0.87	2.79	0.325	0	N/A	6	N/A	N/A	N/A	N/A	60	N/A
19) Cowboy Lk. Channel	4/13/01	3.1	37.58	11.7	13.45	1.75	2.92	0.13	0	0	7.11	151	72	56	16	60	N/A
19) Cowboy Lk. Channel	5/31/01	20.5	68.9	9.34	8.93	-0.41	2.92	<0.13	0	0	7.47	150	84	40	44	60	N/A
19) Cowboy Lk. Channel	6/28/01	25.3	77.54	7.34	8.13	0.79	N/A	<0.13	0	0	7.48	127	96	44	52	60	N/A
19) Cowboy Lk. Channel	6/11/02	No Sample Taken											N/A	N/A	N/A		
20) Cowboy Lk. @ Blind Duck	6/28/01	26.6	79.88	7.82	7.93	0.11	N/A	<0.13	0	0	7.56	138	92	52	40	60	N/A
20) Cowboy Lk. @ Blind Duck	6/11/02	24.6	76.28	7.9	8.24	0.34	2.02	<0.13	0	0.1	8.68	130	N/A	N/A	N/A	60	N/A

July 8, 2002 Rain Event Sampling for the U.S. Highway 2 Cooridor near the Iron Mountain/Breitung Township Boundary

The rain event produced heavy rain and thundershower episodes from approximately 8:30 AM to 10:15 AM.

	Temp. °C	Temp. °F	DO mg/L	DO Sat. mg/L	DO Defct. mg/L	BOD mg/L	Ammonia ppm	Nitrate ppm	Phosphate ppm	pH	Conductivity um	Turbidity cm	See Chart ??-?? For Heavy Metals Data	See Chart ??-?? For Volatile Organics Data	Time In	Time Out
1) North U.S.2 Ditch at U.S. Autos	25.7	78.26	7.05	8.07	1.02	6.32	<0.13	4.4	0.4	6.88	110	0.08	Yes	Yes	8:40 AM	8:46 AM
White Water & Associates Results								2.8	Total P-0.18			TSS-100 mg/L				
2) South U.S.2 Ditch at the discharge to Poor Farm Creek	26.7	80.06	7.46	7.92	0.46	6.73	<0.13	0	0.4	6.7	130	0.08	Yes	Yes	8:55 AM	9:00 AM
White Water & Associates Results								5.5	Total P-0.11			TSS-95 mg/L				
3) Dickinson Co. Healthcare Systems Lawn runoff where the northwest basin discharge enters U.S.2 ditch	N/A	N/A	N/A	N/A	N/A	N/A	<0.13	0	2	7.31	40	N/A	N/A	N/A	9:25 AM	9:30 AM
White Water & Associates Results								1.5	Total P-0.52			TSS-39 mg/L				
4) Dickinson Co. Healthcare Systems discharge pipe from southeast basin	23.9	75.02	6.7	8.35	1.65	5.96	<0.13	0	0.3	7.09	40	40	Yes	Yes	9:45 AM	10:00 AM
White Water & Associates Results								1.3	Total P-0.12			TSS-34 mg/L				
5) Dickinson Co. Healthcare Systems discharge pipe from northwest basin	25.1	77.18	5.62	8.16	2.54	4.86	<0.13	0	0.2	6.91	50	15	Yes	Yes	10:15 AM	10:15 AM
White Water & Associates Results								2.1	Total P-ND			TSS-55 mg/L				
6) North U.S.2 at Days Inn driveway-- Just east of Vacant Terraced land	**This rain event did not produce runoff from this land area as of 10:35 a.m.**															
7) North WhiteBirch Lake (Northeast Quadrant of Lake)	20.1	68.18	5.3	9.00	3.70	4.55	<0.13	4.4	0.2	7.04	370	5	N/A	N/A	11:00 AM	11:15 AM
White Water & Associates Results								0.8	Total P-0.09			TSS-362 mg/L				
8) South White Birch Lake (Southwest Quadrant of Lake)	26.4	79.52	7.8	7.96	0.16	1.45	<0.13	0	0.1	8.02	390	60+	N/A	N/A	12:05 PM	12:10 PM
White Water & Associates Results								0.3	Total P-ND			TSS-5 mg/L				
9) Poor Farm Creek at the Outlet of the South WhiteBirch Lake	18.5	65.3	8.35	9.31	0.96	2.62	<0.13	0	0.2	7.63	440	60+	N/A	N/A	12:25 PM	12:35 PM
White Water & Associates Results								0.5	Total P-0.02			TSS-5 mg/L				
10) K-Mart Stormwater Pipe Discharge	24.6	76.28	7.9	8.24	0.34	7.1	<0.13	0	1	7.61	60	32	N/A	N/A	9:10 AM	9:17 AM
White Water & Associates Results								3.8	Total P-0.34			TSS-33 mg/L				

Updated for the FCWS Management Plan 5/16/02. **Fumee Creek Watershed Project water quality results through July 1, 2001.**

[ ] Equals a water quality flag.

Equals a possible water quality concern or shift in test results.

	Date	Temp. °C	Temp. °F	DO mg/L	DO Sat. mg/L	DO Defct. mg/L	BOD mg/L	Ammonia ppm	Nitrate ppm	Phosphate ppm	pH	Conductivity um	Total Hardness	Calcium Hardness	Magnesium Hardness	Turbidity cm
1) Crystal Lk. Inlet	11/14/00	5.2	41.36	10.88	12.72	1.84	4.33	0.25	0	0	5.5	N/A	N/A	N/A	N/A	N/A
1) Crystal Lk. Inlet	4/12/01	1.5	34.7	9.1	14.05	4.95	1.77	0.325	0	0	8.6	46	24	16	8	39
1) Crystal Lk. Inlet	5/30/01	16.5	61.7	8.21	9.71	1.50	2.27	<0.13	0	0	7.53	748	128	72	56	60
1) Crystal Lk. Inlet	6/27/01	27.3	81.14	9.7	7.83	-1.87	N/A	<0.13	0	0	8.59	551	96	48	48	60
1) Crystal Lk. Inlet	6/11/02	23.1	73.58	8.79	8.48	-0.31	2	<0.13	0	0.1	8.64	660	N/A	N/A	N/A	60
1) White Water Results	6/11/02								ND	Total P-0.07						
2) Crystal Lk. Med. Park	11/14/00	4.8	40.64	9.7	12.86	3.16	2.52	0.1	0	0	6	N/A	N/A	N/A	N/A	N/A
2) Crystal Lk. Med. Park	4/12/01	2.6	36.68	10.18	13.64	3.46	5.94	0.13	0	0	8.5	116	52	20	32	60
2) Crystal Lk. Med. Park	5/30/01	16.8	62.24	10.04	9.65	-0.39	2.84	<0.13	0	0	7.68	713	124	68	56	60
2) Crystal Lk. Med. Park	6/27/01	23.3	73.94	8.23	8.45	0.22	N/A	<0.13	0	0	7.99	509	112	48	64	60
2) Crystal Lk. Med. Park	6/11/02	23.6	74.48	9.02	8.40	-0.62	4.17	<0.13	0	0	8.6	660	N/A	N/A	N/A	60
3) Poor Farm Ck. HW	11/22/00	5.3	41.54	10.1	12.69	2.59	1.37	0.13	0	0	7	521	N/A	N/A	N/A	N/A
3) Poor Farm Ck. HW	4/12/01	6.3	43.34	10.84	12.37	1.53	2.32	0.325	0	0.1	7.45	487	232	152	80	60
3) Poor Farm Ck. HW	5/30/01	8.8	47.84	8.78	11.61	2.83	1.65	<0.13	0	0	7.44	564	276	160	116	60
3) Poor Farm Ck. HW	6/27/01	12.6	54.68	7.9	10.60	2.70	N/A	<0.13	0	0.1	7.67	477	268	144	124	60
3) Poor Farm Ck. HW	6/11/02	14.2	57.56	8.42	10.22	1.80	1.31	<0.13	0	0.1	8.57	430	N/A	N/A	N/A	60
4) Poor Farm Ck. Mouth	11/22/00	1.2	34.16	12.8	14.17	1.37	2.12	0.13	4.4	0	7	489	N/A	N/A	N/A	N/A
4) Poor Farm Ck. Mouth	4/12/01	6.6	43.88	11.73	12.27	0.54	2.18	0.325	0	0	7.94	510	204	108	96	60
4) Poor Farm Ck. Mouth	5/30/01	12.2	53.96	10.98	10.70	-0.28	2.33	<0.13	0	0	7.86	610	244	224	20	60
4) Poor Farm Ck. Mouth	6/27/01	21.8	71.24	8.56	8.70	0.14	N/A	<0.13	0	0	8.11	519	240	120	120	60
4) Poor Farm Ck. Mouth	6/11/02	17.5	63.5	8.63	9.50	0.87	1.62	<0.13	4.4	0.1	8.5	490	N/A	N/A	N/A	60
5) Jones Ck. HW	11/22/00	1.9	35.42	11.95	13.90	1.95	2.09	0.325	8.8	0	7	1057	N/A	N/A	N/A	N/A
5) Jones Ck. HW	4/12/01	8.2	46.76	10.44	11.78	1.34	2.15	0.13	2.2	0	7.87	1264	340	224	116	60
5) Jones Ck. HW	5/30/01	11.7	53.06	9.82	10.82	1.00	1.5	0.13	0	0	7.85	1334	424	256	168	60
5) Jones Ck. HW	6/27/01	19.2	66.56	8.05	9.17	1.12	N/A	<0.13	4.4	0	8.03	1113	428	204	224	60
5) Jones Ck. HW	6/11/02	16.5	61.7	8.15	9.71	1.56	1.48	<0.13	2.2	0.1	8.19	1030	N/A	N/A	N/A	60
6) TimberLane Ck.	11/22/00	0.3	32.54	13.35	14.53	1.18	3.42	0.325	0	0	6	438	N/A	N/A	N/A	N/A
6) TimberLane Ck.	4/12/01	3.5	38.3	12.15	13.31	1.16	3.09	0.13	0	0	7.76	290	140	76	64	60
6) TimberLane Ck.	5/31/01	10.5	50.9	9.45	11.14	1.69	1.1	<0.13	0	0	7.86	541	256	140	116	60
6) TimberLane Ck.	6/28/01	16.3	61.34	8.66	9.75	1.09	N/A	<0.13	0	0	7.89	541	304	168	136	60
6) TimberLane Ck.	6/11/02	16.3	61.34	8.75	9.75	1.00	1.17	<0.13	0	0	8.64	290	N/A	N/A	N/A	60

	Date	Temp. °C	Temp. °F	DO mg/L	DO Sat. mg/L	DO Defct. mg/L	BOD mg/L	Ammonia ppm	Nitrate ppm	Phosphate ppm	pH	Conductivity um	Total Hardness	Calcium Hardness	Magnesium Hardness	Turbidity cm
7) Fumee Ck. HW	11/22/00	1.2	34.16	12.51	14.17	1.66	3.09	0.13	0	0	6	279	N/A	N/A	N/A	N/A
7) Fumee Ck. HW	4/12/01	5.2	41.36	11.28	12.72	1.44	2.85	0.325	0	0	7.7	255	124	76	48	60
7) Fumee Ck. HW	5/31/01	11.3	52.34	9.41	10.92	1.51	1.25	<0.13	0	0	7.84	334	184	84	100	60
7) Fumee Ck. HW	6/28/01	21	69.8	7.4	8.84	1.44	N/A	<0.13	0	0	7.82	297	192	96	96	60
7) Fumee Ck. HW	6/11/02	19	66.2	7.28	9.21	1.93	1.18	<0.13	0	0	8.69	290	N/A	N/A	N/A	60

8) Fumee Ck. Mouth	11/22/00	0.8	33.44	12.87	14.33	1.46	2.92	0.325	0	0	7	349	N/A	N/A	N/A	N/A
8) Fumee Ck. Mouth	4/12/01	5.3	41.54	11.72	12.69	0.97	3.03	0.325	0	0	7.99	290	144	84	60	60
8) Fumee Ck. Mouth	5/31/01	9.4	48.92	10.14	11.44	1.30	2.25	<0.13	0	0	7.88	345	200	104	96	60
8) Fumee Ck. Mouth	6/28/01	18.3	64.94	8	9.34	1.34	N/A	<0.13	0	0	7.93	329	180	108	72	60
8) Fumee Ck. Mouth	6/11/02	18.3	64.94	8.3	9.34	1.04	1.42	<0.13	0	0	8.73	320	N/A	N/A	N/A	60
9) White Ck. @ Amoco	11/22/00	0.2	32.36	12.27	14.57	2.30	2.04	0.325	8.8	0	6	415	N/A	N/A	N/A	N/A
9) White Ck. @ Amoco	4/12/01	4.7	40.46	10.12	12.89	2.77	3.59	0.13	4.4	0	7.34	302	180	108	72	60
9) White Ck. @ Amoco	5/30/01	12.3	54.14	10.35	10.67	0.32	1.8	<0.13	26.4	0	7.83	483	240	120	120	60
9) White Water Results	5/30/01	**Chloride - 16 mg/L (ppm)**							2.6	0.01						
9) White Ck. @ Amoco	6/27/01	21.3	70.34	7.95	8.79	0.84	N/A	<0.13	13.2	0	8.01	403	244	140	104	60
9) White Water Results	6/27/01	Before Rain							3.7	0.02						
9) White Ck. @ Amoco	6/11/02	17.2	62.96	8.75	9.56	0.81	1.05	<0.13	8.8	0	8.7	390	N/A	N/A	N/A	60
10-A) White Ck. @ U.S. 2	11/22/00	8.8	47.84	9.9	11.61	1.71	0.5	0.325	8.8	0	6.5	492	N/A	N/A	N/A	N/A
10-A) White Ck. @ U.S. 2	4/12/01	9.5	49.1	10.3	11.41	1.11	3.45	<0.13	8.8	0	7.74	545	260	180	80	25
10-A) White Ck. @ U.S. 2	5/30/01	10.2	50.36	1.22	11.22	10.00	0.06	<0.13	0	0.1	7.85	851	380	212	168	60
10-A) White Water Results	5/30/01	**Chloride - 46 mg/L (ppm)**							1.1	0.23					**After Rain--**	27
10-A) White Ck. @ U.S. 2	6/27/01	15.4	59.72	7.96	9.95	1.99	N/A	<0.13	0	0	7.87	466	248	124	124	60
10-A) White Water Results	6/27/01	**Before Rain**							0.6	0.02				Total Suspended Solids		ND
10-A) White Water Results	6/27/01	**After Rain**							1.4	0.15				Total Suspended Solids		332 mg/L
10-A) White Ck. @ U.S. 2	6/11/02	14.9	58.82	8.07	10.06	1.99	6.31	<0.13	4.4	0	8.64	460	N/A	N/A	N/A	60
10-A) White Water Results	6/11/02								1.6	ND						
10-B) White Ck. @ Kimberly	11/22/00	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-B) White Ck. @ Kimberly	4/12/01	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-B) White Ck. @ Kimberly	5/30/01	12.4	54.32	4.59	10.65	6.06	0.5	<0.13	8.8	0.1	7.88	771	358	168	190	60
10-B) White Water Results	5/30/01	**Chloride - 46 mg/L (ppm)**							1.4	0.02						
10-B) White Ck. @ Kimberly	6/27/01	21.3	70.34	7.95	8.79	0.84	N/A	<0.13	13.2	0	7.99	403	266	148	118	60
10-B) White Water Results	6/27/01	After Rain				**Chloride - 16 mg/L (ppm)**			3.8	0.01						
10-B) White Ck. @ Kimberly	6/11/02	18.8	65.84	9.66	9.25	-0.41	2.13	<0.13	8.8	0	8.76	400	N/A	N/A	N/A	60
10-C) White Ck. D/S WWTP	6/27/01	**White Water Results after rain event**						Chloride - 48 mg/L	8.4	0.16						
10-C) White Ck. D/S WWTP	6/11/02	17	62.6	7.7	9.61	1.91	1.7	<0.13	28.4	0.3	8.43	520	N/A	N/A	N/A	60
10-D) White Ck. U/S Cem. Rd.	6/11/02	16.2	61.16	9.77	9.77	0.00	2.37	<0.13	17.6	0.3	8.61	620	N/A	N/A	N/A	60
11) White Ck. @ WPA Rd.	11/22/00	4.4	39.92	11.76	13.00	1.24	2.11	0.13	17.6	0.1	6.5	657	N/A	N/A	N/A	N/A
11) White Ck. @ WPA Rd.	4/12/01	6.7	44.06	10.53	12.24	1.71	1.88	0.325	8.8	0	7.84	418	176	116	60	60
11) White Ck. @ WPA Rd.	5/30/01	14.6	58.28	9.5	10.12	0.62	3.63	<0.13	17.6	0.5	7.8	736	328	196	132	26
11) White Ck. @ WPA Rd.	6/27/01	17.1	62.78	8.65	9.58	0.93	N/A	<0.13	13.2	0.2	8.05	625	320	180	140	60
11) White Water Results	6/27/01	Before Rain							4.7	0.08						
11) White Ck. @ WPA Rd.	6/11/02	16.5	61.7	9.4	9.71	0.31	1.55	<0.13	8.8	0.2	8.59	590	N/A	N/A	N/A	60
		Temp.	**Temp.**	**DO**	**DO Sat.**	**DO Defct.**	**BOD**	**Ammonia**	**Nitrate**	**Phosphate**		**Conductivity**	**Total**	**Calcium**	**Magnesium**	**Turbidity**
	Date	**°C**	**°F**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**ppm**	**ppm**	**ppm**	**pH**	**um**	**Hardness**	**Hardness**	**Hardness**	**cm**
12) LaFaive Ck (1st one)	11/22/00	0.9	33.62	13.15	14.29	1.14	2.8	0.325	0	0	6.5	217	N/A	N/A	N/A	N/A
12) LaFaive Ck (1st one)	4/12/01	4.1	39.38	12.35	13.10	0.75	2.98	<0.13	0	0	7.95	209	120	68	52	60

12) LaFaive Ck (1st one)	5/30/01	13.4	56.12	9.9	10.40	0.50	1.06	<0.13	0	0	7.58	230	128	68	60	60
12) LaFaive Ck (1st one)	6/27/01	18.1	64.58	8.6	9.38	0.78	N/A	<0.13	0	0	7.82	223	140	80	60	60
12) LaFaive Ck (1st one)	6/11/02	No Sample Taken											N/A	N/A	N/A	
13) Rocconi Ck. (2nd one)	11/22/00	4.9	40.82	9.52	12.82	3.30	0.89	0.13	0	0	7	631	N/A	N/A	N/A	N/A
13) Rocconi Ck. (2nd one)	4/12/01	4.9	40.82	10.86	12.82	1.96	2.62	<0.13	0	0	7.56	626	300	220	80	60
13) Rocconi Ck. (2nd one)	5/30/01	8.8	47.84	8.86	11.61	2.75	0.72	<0.13	0	0	7.78	736	356	196	160	60
13) Rocconi Ck. (2nd one)	6/27/01	11.5	52.7	7.94	10.87	2.93	N/A	<0.13	0	0	7.78	583	340	180	160	60
13) Rocconi Ck. (2nd one)	6/11/02	No Sample Taken											N/A	N/A	N/A	
14) Lake Mary (across)	None	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14) Lake Mary (across)	4/12/01	3.3	37.94	10.6	13.38	2.78	3.75	0.13	0	0	7.3	35	48	16	32	60
14) Lake Mary (across)	5/30/01	20.7	69.26	9.98	8.89	-1.09	3.48	<0.13	0	0	7.13	380	76	36	40	60
14) Lake Mary (across)	6/27/01	26.6	79.88	8.34	7.93	-0.41	N/A	<0.13	0	0	7.6	350	92	40	52	60
14) Lake Mary (across)	6/11/02	24.8	76.64	7.73	8.21	0.48	2.74	<0.13	0	0	8.14	450	N/A	N/A	N/A	60
16) Strawberry Lk.	11/22/00	3.1	37.58	7.5	13.45	5.95	2.21	0.65	0	0	7	652	N/A	N/A	N/A	N/A
16) Strawberry Lk.	4/12/01	3.1	37.58	11.7	13.45	1.75	4.09	0.13	0	0	7.74	209	84	52	32	60
16) Strawberry Lk.	5/30/01	20.6	69.08	10.35	8.91	-1.44	1.74	<0.13	0	0.1	7.9	725	284	132	152	60
16) Strawberry Lk.	6/27/01	26.5	79.7	10.15	7.95	-2.20	N/A	<0.13	0	0	8.25	519	240	88	152	60
16) Strawberry Lk.	6/11/02	24.7	76.46	10.84	8.22	-2.62	1.94	<0.13	0	0.1	8.67	620	N/A	N/A	N/A	60
17) Strawberry Ck.	11/22/00	0.1	32.18	11.9	14.61	2.71	1.45	0.325	0	0	7	571	N/A	N/A	N/A	N/A
17) Strawberry Ck.	4/12/01	2.6	36.68	11.9	13.64	1.74	5.49	0.13	0	0.2	7.85	476	228	140	88	21
17) Strawberry Ck.	5/30/01	13.4	56.12	9.32	10.40	1.08	0.97	<0.13	0	0.1	7.88	621	336	140	196	60
17) Strawberry Ck.	6/27/01	21.6	70.88	6.79	8.74	1.95	N/A	<0.13	0	0.3	7.93	488	296	136	160	31
17) Strawberry Ck.	6/11/02	21.5	70.7	7.04	8.75	1.71	1.79	<0.13	0	0.2	8.52	560	N/A	N/A	N/A	60

	Date	Temp. °C	Temp. °F	DO mg/L	DO Sat. mg/L	DO Defct. mg/L	BOD mg/L	Ammonia ppm	Nitrate ppm	Phosphate ppm	pH	Conductivity um	Total Hardness	Calcium Hardness	Magnesium Hardness	Turbidity cm
18) Cowboy Lk. Boat Dock	10/27/01	11.4	52.52	9.85	10.90	1.05	4.38	<0.13	0	N/A	8.25	N/A	N/A	N/A	N/A	60
18) Cowboy Lk. Boat Dock	4/13/01	0.3	32.54	11.2	14.53	3.33	4.49	0.13	0	0	6.73	58	72	20	52	60
18) Cowboy Lk. Boat Dock	5/31/01	20.5	68.9	9.4	8.93	-0.47	2.15	<0.13	0	0	7.63	138	100	48	52	60
18) Cowboy Lk. Boat Dock	6/28/01	27	80.6	7.63	7.87	0.24	N/A	<0.13	0	0	7.5	138	84	48	36	60
18) Cowboy Lk. Boat Dock	6/11/02	25.3	77.54	9.33	8.13	-1.20	2.38	<0.13	0	0.1	9.06	120	N/A	N/A	N/A	60
19) Cowboy Lk. Channel	10/27/00	14.5	58.1	9.28	10.15	0.87	2.79	0.325	0	N/A	6	N/A	N/A	N/A	N/A	60
19) Cowboy Lk. Channel	4/13/01	3.1	37.58	11.7	13.45	1.75	2.92	0.13	0	0	7.11	151	72	56	16	60
19) Cowboy Lk. Channel	5/31/01	20.5	68.9	9.34	8.93	-0.41	2.92	<0.13	0	0	7.47	150	84	40	44	60
19) Cowboy Lk. Channel	6/28/01	25.3	77.54	7.34	8.13	0.79	N/A	<0.13	0	0	7.48	127	96	44	52	60
19) Cowboy Lk. Channel	6/11/02	No Sample Taken											N/A	N/A	N/A	
20) Cowboy Lk. @ Blind Duck	6/28/01	26.6	79.88	7.82	7.93	0.11	N/A	<0.13	0	0	7.56	138	92	52	40	60
20) Cowboy Lk. @ Blind Duck	6/11/02	24.6	76.28	7.9	8.24	0.34	2.02	<0.13	0	0.1	8.68	130	N/A	N/A	N/A	60

July 8, 2002 Rain Event Sampling for the U.S. Highway 2 Cooridor near the Iron Mountain/Breitung Township Boundary

The rain event produced heavy rain and thundershower episodes from approximately 8:30 AM to 10:15 AM.

	Temp. °C	Temp. °F	DO mg/L	DO Sat. mg/L	DO Defct. mg/L	BOD mg/L	Ammonia ppm	Nitrate ppm	Phosphate ppm	pH	Conductivity um	Turbidity cm	See Chart ??-?? For Heavy Metals Data	See Chart ??-?? For Volatile Organics Data	Time In
1) North U.S.2 Ditch at U.S. Autos	25.7	78.26	7.05	8.07	1.02	6.32	<0.13	4.4	0.4	6.88	110	0.08	Yes	Yes	8:40 AM
White Water & Associates Results								2.8	Total P-0.18			TSS-100 mg/L			
2) South U.S.2 Ditch at the discharge to Poor Farm Creek	26.7	80.06	7.46	7.92	0.46	6.73	<0.13	0	0.4	6.7	130	0.08	Yes	Yes	8:55 AM
White Water & Associates Results								5.5	Total P-0.11			TSS-95 mg/L			
3) Dickinson Co. Healthcare Systems Lawn runoff where the northwest basin discharge enters U.S.2 ditch	N/A	N/A	N/A	N/A	N/A	N/A	<0.13	0	2	7.31	40	N/A	N/A	N/A	9:25 AM
White Water & Associates Results								1.5	Total P-0.52			TSS-39 mg/L			
4) Dickinson Co. Healthcare Systems discharge pipe from southeast basin	23.9	75.02	6.7	8.35	1.65	5.96	<0.13	0	0.3	7.09	40	40	Yes	Yes	9:45 AM
White Water & Associates Results								1.3	Total P-0.12			TSS-34 mg/L			
5) Dickinson Co. Healthcare Systems discharge pipe from northwest basin	25.1	77.18	5.62	8.16	2.54	4.86	<0.13	0	0.2	6.91	50	15	Yes	Yes	10:15 AM
White Water & Associates Results								2.1	Total P-ND			TSS-55 mg/L			
6) North U.S.2 at Days Inn driveway-- Just east of Vacant Terraced land	**This rain event did not produce runoff from this land area as of 10:35 a.m.**														
7) North WhiteBirch Lake (Northeast Quadrant of Lake)	20.1	68.18	5.3	9.00	3.70	4.55	<0.13	4.4	0.2	7.04	370	5	N/A	N/A	11:00 AM
White Water & Associates Results								0.8	Total P-0.09			TSS-362 mg/L			
8) South White Birch Lake (Southwest Quadrant of Lake)	26.4	79.52	7.8	7.96	0.16	1.45	<0.13	0	0.1	8.02	390	60+	N/A	N/A	12:05 PM

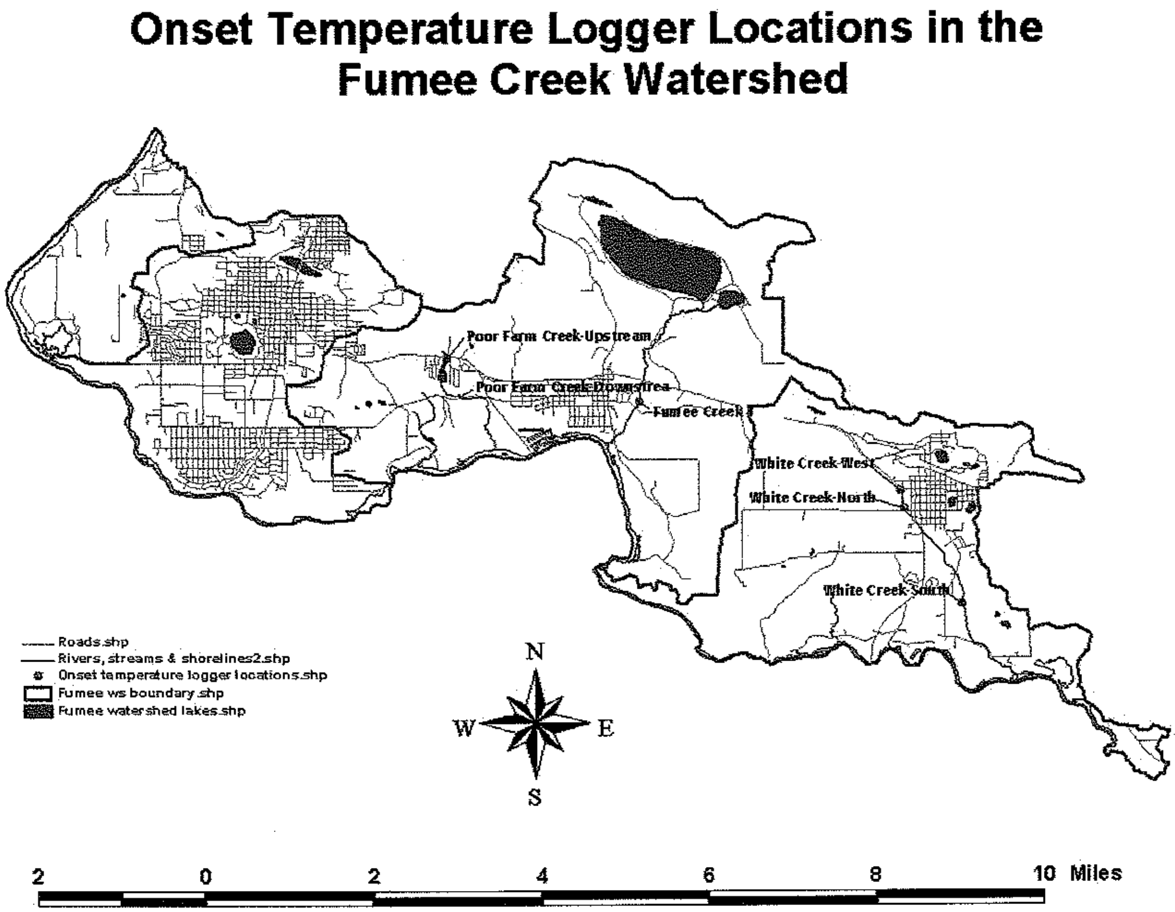
White Water & Associates Results								0.3	Total P-ND			TSS-5 mg/L			
9) Poor Farm Creek at the Outlet of the South WhiteBirch Lake	18.5	65.3	8.35	9.31	0.96	2.62	<0.13	0	0.2	7.63	440	60+	N/A	N/A	12:25 PM
White Water & Associates Results								0.5	Total P-0.02			TSS-5 mg/L			
10) K-Mart Stormwater Pipe Discharge	24.6	76.28	7.9	8.24	0.34	7.1	<0.13	0	1	7.61	60	32	N/A	N/A	9:10 AM
White Water & Associates Results								3.8	Total P-0.34			TSS-33 mg/L			

Temperature Loggers

Onset ™ Temperature loggers were placed at six locations in the watershed during the months of May through November. Time, date, and temperature in degrees C and F were recorded every fifteen minutes during this time frame. The fifteen minute data record interval was utilized to determine the impact of stormwater discharges in upstream locations. Another objective of the temperature logger deployment was to identify times of the year that the recorded temperatures met the ranges required by the State of Michigan for the coldwater fishery designated use. Loggers were placed on creeks that had been previously designated coldwater trout streams (Poor Farm Creek, Fumee Creek, White Creek). Location of temperature logger placement is found in **Figure 20.**

Fumee Creek only had one temperature logger deployed about one-half mile south of U.S Highway 2. One upstream and one downstream logger location on Poor Farm Creek was used to help determine the initial impact of the U.S. Highway 2 critical area, the warming or moderating affect of the two ponds located directly downstream (south) of the highway, and the continued temperature range degradation or improvement as the water flowed downstream. White Creek deployment locations were identified to assist in determining the stormwater and Aragon Mine water discharges at U.S. Highway 2. Locations were also chosen to show the warming affect that the excessively wide, shallow, low velocity, and sand filled creek channel has on the temperature of the water over short and long distances. As a result loggers were deployed just west of the 90-degree bend to the south, upstream of Kimberly Road, and near the Norway Cemetery.

Figure 20. Temperature Logger Locations



Temperature logger data is available in the Appendix G.

Road Stream Crossings

Approximately 20 road stream crossings were inventoried according to the DEQ Protocol (Appendix H). Based on this inventory, a ranking of severity of impairment of the road crossings was evolved. Impairments focus on the potential for non-point source pollutants (primarily sediment and nutrients) to be added to the watercourse at each location. Unstable side slopes(often the result of too short a culvert), under-capacity culverts (as evidenced by up and downstream bank scouring), evidence of road sediment being directly deposited into stream, condition of riparian vegetation, surrounding land use, and visual interpretation of water clarity are some of the factors subjectively quantified in this survey.

V
Prioritized Pollutants and Causes

After the inventory stage, the Watershed Council looked at the designated uses again and ranked the particular pollutants that played a part in threatening or impairing that use. The pollutants that threaten multiple designated uses will be most important to try to reduce through systems of Best Management Practices and local ordinance changes. They are summarized in Figure 21. below.

Figure 21. Prioritization of Pollutants Affecting Designated Uses

Designated Use	Rank	Designated Use Classification	Pollutants Affecting the Designated Use	Pollutant Priority Ranking
Coldwater Fishery	1	Threatened	Temperature	1
			Sediment	2
			Depressed dissolved oxygen	3
			Nutrients (Nitrogen & Phosphorus	4
			Hydrologic flow fluctuations (k)	5
			Oils, grease, and heavy metals	6
			Organic Matter	7
Warmwater Fishery	2	Threatened	Sediment	1
			Temperature	2
			Depressed dissolved oxygen	3
			Nutrients (Nitrogen & Phosphorus	4
			Hydrologic flow fluctuations	5
			Exotic Species	6
			Oils, grease, and heavy metals	7
			Organic Matter	8
Other indigenous aquatic life and wildlife	3	Threatened	Sediment	1
			Depressed dissolved oxygen	2
			Nutrients (Nitrogen & Phosphorus	3
			Temperature	4
			Hydrologic flow fluctuations	5
			Exotic Species	6
			Oils, grease, and heavy metals	7
			Organic Matter	8
Total Body Contact - Recreation	4	Threatened	Bacteria & Pathogens (CSO)	1
			Oils, grease, and heavy metals	2
			Nutrients	3
			Exotic Species	4
Partial Body Contact - Recreation	5	Threatened	Bacteria & Pathogens (CSO)	1
			Oils, grease, and heavy metals	2
			Nutrients	3
			Exotic Species	4
Industrial Water Supply	6	Threatened	Sediment & Suspended Solids	1
			Exotic Species	2

Navigation	7	Impaired	Nutrients Exotic Species Sediment	1 2 3
Agricultural	8	Threatened	Nutrients	1
Public Water Supply	9	Threatened	Bacteria Oils, grease, and heavy metals Nutrients (Nitrogen & Phosphorus Sediment	1 2 3 4

The pollutants are ranked according to the Watershed Council and Project Manager's perceived seriousness of the impact. The sources that potentially contribute these pollutants are ranked according to their suspected degree of contribution.

Figure 22: Ranked Pollutants and Sources in Fumee Creek Watershed

Rank	Pollutants	Rank	Sources
1	Sediment	1	Urban Stormwater
		2	Transportation
		3	Streambank Erosion
		4	Recreation
		5	Residential (Riparian)
		6	Mining
		7	Construction
2	Nutrients	1	Sediment from all sources
		2	Residential (Urban/Riparian)
		3	Urban Stormwater
		4	Agriculture
3	Hydrologic Flow	1	Urban Stormwater
		2	Mining
4	Depressed DO (BOD)	1	Mining
		2	Residential (Urban/Riparian)
		3	Urban Stormwater
5	Temperature	1	Urban Stormwater
		2	Residential (Riparian)
		3	Sediment
6	Exotic Species	1	Recreation
7	Bacteria & Pathogens	1	Urban Stormwater
		2	Agriculture
8	Oil, grease & metals	1	Urban Stormwater
9	Debris & Litter	1	Urban Stormwater
		2	Residential

After prioritizing the pollutants and their sources (general categories of activities that contribute pollutants to the watershed), more specific causes for those general sources were outlined after inventorying the watershed and interviewing watershed partners. The perceived causes of the pollutant sources are ranked in the table below. The causes are ranked on their potential degree of contribution and the ability to be remediated.

Figure 23. Ranking of Pollutants, Sources and Causes in the Fumee Creek Watershed

Rank	Pollutants	Rank	Sources	Rank	Causes
1	Sediment	1	Urban Stormwater	1	Lack of ordinances requiring on-site treatment of stormwater
				2	Discharge directly to waterbody without treatment
				3	Roadside ditch erosion
				4	Construction site erosion
				5	Clean out stormwater catch basins more frequently
		2	Transportation	1	Undersized culverts altering hydrologic flow
				2	Roadside ditch erosion
				3	Steep & unprotected side slopes
				4	Gravel road and slope/bank erosion at stream crossing
				5	Culverts not aligned with stream channel
		3	Streambank Erosion	1	Human access
				2	Hydrologic flow fluctuations
				3	Stream widening from sediment deposition
		4	Recreation	1	Unrestricted/unguided human foot traffic
				2	Unrestricted/unguided Off-Road Vehicle traffic
				3	Lack of proper slope protection near structures
				4	Steep, unstable, & unvegetated slopes
		5	Residential (Riparian)	1	Conversion of deep rooted vegetation to shallow rotting turf grass lawns
		6	Mining	1	Uncontrolled sediment laden stormwater runoff from gravel pit operations
				2	Lack of local ordinances & enforcement requiring slopes to be properly graded, stabilized, and vegetated

		7	Construction	1	Lack of regulations enforcement
				2	Lack of necessary soil & sedimentation control practices
				3	Lack of maintaining soil and sedimentation control practices
				4	Lack of buffer areas next to waterbodies
				5	Lack of phasing construction activities and fast revegetation of open soils
2	Nutrients	1	Sediment from all sources	1	**See sediment pollution information
		2	Residential (Urban/Riparian)	1	Poor stormwater management practies (no nutrient removal treatment)
				2	Lack of riparian bufferer between lawn and waterbody
				3	Improper application and overuse
				4	Unmaintained septic systems near waterbodies
		3	Urban Stormwater	1	Overflows from combined stormwater and sanitary sewers
				2	Lack of ordinances requiring on-site treatment of stormwater
		4	Agriculture	1	Lack of animal waste systems to properly manage nutrient wastes
3	Hydrologic Flow	1	Urban Stormwater	1	Poor stormwater management practies (lack of detention/retention)
				2	Lack of local ordinances requiring on-site storage and treatment
		2	Mining	1	Highly variable pump discharge -- on or off only design
4	Depressed DO (BOD)	1	Mining	1	Low oxygen content groundwater being pumped
		2	Residential (Urban/Riparian)	1	Poor stormwater management practices (no nutrient removal treatment)
				2	Improper application and overuse of fertilizers
				3	Lack of riparian buffers between turf grass lawns and waterbodies

		3	Urban Stormwater	1	Poor stormwater management practices (warm & no nutrient removal)
5	Temperature	1	Urban Stormwater	1	Heated runoff discharge directly to waterbodies
		2	Residential (Riparian)	1	Conversion of shade providing riparian vegetation to turf grass lawns
		3	Sediment	1	Reducing depth of stream channels and lakes
				2	Sediment filled water is darker and attracts more sunlight
6	Exotic Species	1	Recreation	1	Lack of public education and identification
7	Bacteria & Pathogens	1	Urban Stormwater	1	Overflows from combined stormwater and sanitary sewers
				2	Poor stormwater management practices (no nutrient removal treatment)
		2	Agriculture	1	Lack of animal waste systems to properly manage nutrient wastes
8	Oil, grease & metals	1	Urban Stormwater	1	Poor stormwater management practices (no treatment)
				2	Impervious surfaces
				3	Improper vehicle maintenance and fluid disposal
9	Debris & Litter	1	Urban Stormwater	1	Poor stormwater management practices (no treatment)
		2	Residential	1	Lack of disposal areas and cost

VI

Water Quality Protection Objectives for the Fumee Creek Watershed

Watershed Goals and Objectives

Goal 1: Restore Coldwater Fishery

Objective 1. By reducing Temperature

Activity 1. Maintain stream and lake depth by reducing sedimentation.

Activity 2. Limit heated run-off that is discharged directly to water bodies.

Activity 3. Restore and maintain shaded riparian corridors.

Objective 2. By reducing sediment

*Activity 1.*Stabilizing slopes and conduits receiving run-off from the urban /transportation environment.

Activity 2: Properly stabilize streambanks in the riparian corridor

Activity 3: Reduce the total amount of stormwater runoff and the flash flows by using infiltration, retention, or detention basins at several sites.

Activity 4. Improve stabilization and hydrologic capacity at road stream crossings.

Activity 5. Improve stormwater management practices by requiring on-site treatment of stormwater prior to release into a water body.

Activity 6. Reduce erosion caused by unlimited recreational usage (foot traffic and ORVs) on slopes and banks near streams.

Activity 7. Ensure stricter enforcement of the Soil and Sedimentation Control Laws to reduce construction related soil loss into waterbodies.

Objective 3. Reduce nutrient inputs

Activity 1. Improve stormwater management by requiring on-site treatment of storm water prior to discharging to a waterbody or municipal storm sewer.

Activity 2. Restore and maintain deep rooted vegetation filter in the riparian zones.

Activity 3. Educate residential riparian landowners about proper fertilizer usage and value of riparian buffers.

Activity 4. Reduce nutrients from animal wastes through proper collection, storage, and application.

Objective 4. By improving Hydrologic Flow

Activity 1: Retrofitting and modifying existing stormwater systems to reduce peak flows.

Activity 2: Develop local regulations requiring the use of permanent BMPs to provide storage and treatment of stormwater on individual sites

Activity 3: Alter road crossings to restore natural flows by reducing or eliminating flow restrictions.

Activity 4. Regulate flows from mine pumps.

Objective 5. By eliminating Toxic pollutants (Oils, Grease, Heavy Metals)

Activity 1: Improve stormwater management practices by requiring on-site treatment of stormwater prior to discharging to a waterbody or municipal stormwater system.

Activity 2: Require treatment in hotspot areas where toxic materials accumulate on impervious surfaces.

Activity 3: Inform and educate urban residents serviced by stormwater systems that proper vehicle maintenance and fluid disposal benefits all water quality.

Objective 6. Address suppression of dissolved oxygen/ BOD demand in water bodies

Activity 1. Alter existing mine pump that contributes very low oxygen content to White Creek.

Activity 2. Promote and install riparian buffers to filter residential fertilizer use and limit excessive aquatic plant growth.

Activity 3. Limit direct input of stormwater into water bodies.

Objective 7. To increase public, private landowner and industry awareness of best management practices.

Activity 1. Promote BMPs in a quarterly newsletter, via newspaper articles, workshops, and by signage of projects.

Goal 2: Restore Warmwater Fishery

Objectives 1-7 as above.

Goal 3: Protect Indigenous Aquatic Life and Wildlife

Objectives 1-7 as above.

Goal 4: Improve Total Body Contact for Recreation

Objective 1:By reducing Bacteria & Pathogens

Activity 1: Separate all combined stormwater and sanitary sewer systems to reduce the possibility of having a nutrient filled sewer overflow discharge to a waterbody.

Activity 2: Provide additional treatment of storm water prior to discharge to a waterbody to reduce the possibility of domesticated animal wastes from contributing this pollutant.

Activity 3. Reduce bacteria and pathogens from animal wastes through proper collection, storage and application.

Objective 2: By reducing toxic elements (oils, grease & metals) entering water

Activity 1: Improve stormwater management practices by requiring on-site treatment of stormwater prior to discharging to a waterbody or municipal stormwater system.

Activity 2: Require treatment in hotspot areas where toxic materials accumulate on impervious surfaces.

Activity 3: Inform and educate urban residents serviced by stormwater systems that proper vehicle maintenance and fluid disposal benefits all water quality.

Objective 3. By reducing nutrients entering water body

Activity 1: Improve stormwater management practices by requiring on-site treatment of stormwater prior to discharging to a waterbody or municipal stormwater system

Activity 2: Restore and maintain deep rooted native riparian vegetation that will filter and remove nutrients from lawn area runoff.

Activity 3: Inform and educate watershed residents about the damage excess nutrients cause to waterbodies and the benefits of proper use and application of fertilizers around water.

*Activity 4:R*reduce nutrients from animal wastes through proper collection, storage , and application.

Objective 4. By reducing exotic species

Activity 1: Inform and educate watershed residents about the identification, spread and damaging affects exotic species can have on the aquatic ecosystems.

Goal 5: Improve Partial Body Contact for Recreation

Objectives 1-4 as above.

Goal 6: Improve the Industrial Water Supply

Objective 1: Reduce suspended solids and sediment

Activity 1. Stabilizing slopes and conduits receiving run-off from the urban /transportation environment.

Activity 2: Properly stabilize streambanks in the riparian corridor.

Activity 3: Reduce the total amount of stormwater runoff and the flash flows by using infiltration, retention, or detention basins at several sites.

Activity 4. Improve stabilization and hydrologic capacity at road stream crossings.

Activity 5. Improve stormwater management practices by requiring on-site treatment of stormwater prior to release into a water body.

Activity 6. Reduce erosion caused by unlimited recreational usage (foot traffic and ORVs) on slopes and banks near streams.

Activity 7. Ensure stricter enforcement of the Soil and Sedimentation Control Laws to reduce construction related soil loss into waterbodies.

Objective 2: Reduce exotic species introduction and spread

Activity 1: Inform and educate watershed residents about the identification, spread and damaging affects exotic species can have on the aquatic ecosystems.

Goal 7: Improve Navigation in Cowboy Lake and the Menominee River

Objective 1. Reduce nutrients causing excessive plant growth

Activity 1: Improve stormwater management practices by requiring on-site treatment of stormwater prior to discharging to a waterbody or municipal stormwater system

Activity 2: Restore and maintain deep rooted native riparian vegetation that will filter and remove nutrients from lawn area runoff.

Activity 3: Inform and educate watershed residents about the damage excess nutrients cause to waterbodies and the benefits of proper use and application of fertilizers around water.

Objective 2. Reduce introduction and spread of exotic species

Activity 1: Inform and educate watershed residents about the identification, spread and damaging affects exotic species can have on the aquatic ecosystems.

Objective 3. Reduce sediment deposited in stream channels

*Activity 1.*Stabilizing slopes and conduits receiving run-off from the urban /transportation environment.

Activity 2: Properly stabilize streambanks in the riparian corridor

Activity 3: Reduce the total amount of stormwater runoff and the flash flows by using infiltration, retention, or detention basins at several sites.

Activity 4. Improve stabilization and hydrologic capacity at road stream crossings.

Activity 5. Improve stormwater management practices by requiring on-site treatment of stormwater prior to release into a water body.

Activity 6. Reduce erosion caused by unlimited recreational usage (foot traffic and ORVs) on slopes and banks near streams.

Activity 7. Ensure stricter enforcement of the Soil and Sedimentation Control Laws to reduce construction related soil loss into waterbodies.

Implementation of Water Quality Goals

To reach the goals listed above, physical improvements and educational outreach must be enacted. The tasks listed below are steps required to enact water quality improvements in a method compatible with the Michigan Department of Environmental Quality policies aimed at protecting Michigan waters from non-point source pollution, thereby complying with state and federal laws.

Figure 24. Tasks and Watershed Goals That Will Be Achieved

Task	Implementation Category	Goals. Objectives. Activities Addressed
Task 1:	Install a series of Best Management Practices on 7 Urban Stream Channel Restoration sites.	1.1.3, 1.2.2, 1.3.1, 1.4.4, 1.7.1
Task 2:	Install a series of Best Management Practices related to treatment, reduction of Urban Stormwater impacts	1.1.2, 1.2.3, 1.2.5, 1.3.1, 1.4.1, 1.4.2, 1.5.1, 1.5.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.3.1, 6.1.3, 6.1.5, 7.1.1
Task 3:	Install a series of Best Management Practices to remediate Transportation-related Sites	1.2.1, 1.2.4, 1.4.3, 6.1.4
Task 4:	Install a series of Best Management Practices to repair 3 Recreational Trail sites.	1.2.4, 1.3.3, 2.2.4
Task 5:	Install a series of Best Management Practices to restore 6 Riparian Corridor/Runoff Filter sites.	1.1.3, 1.2.2, 1.3.2, 1.3.3, 1.6.2, 4.3.2, 7.1.2
Task 6:	Implement a series of Best Management Practices to Stabilize Streambank/Shoreline sites (9).	1.1.1, 1.1.3, 1.2.2, 1.2.4, 6.1.4, 6.1.2
Task 7:	Install a series of Best Management Practices on 3 Agricultural sites.	1.3.4, 4.1.3, 4.3.4
Task 8:	Secure a partnership agreement with landowner or corresponding agency in order to complete the the identified BMPs on a site. The amount and type of landowner contribution should also be determined. Partner contributions include match categories such as labor, equipment, materials, and dollars toward the completion of a project.	Goals 1-7, Site specific Objectives, Activities
Task 9:	Develop Water Quality Resource Management Plans (WQRMP) for each implementation site. WQRMPs require the project manager to look critically at a site to determine the most suitable BMPs to address all water resource concerns. Components of a WQRMP include the location of the site, description of site characteristics, a background of what has occurred on the site in the past, the resource concerns, goals for the site, site	Goals 1-7, Site Specific Objective & Activities

	hydrology, design calculations, costs for BMPs, and a Plan of Operation and Maintenance.	
Task 10:	A professionally engineered site design must be completed according to state of Michigan standards and specifications. An engineered design is required to properly size and install BMPs on a site and the design must be reviewed and approved by the MDEQ.	Goals 1-7
Task 11:	Proper federal, state, and local permits must be obtained as needed prior to completing any portion of a BMP project near a waterbody.	Goals 1-7
Task 12:	Implement an Information and Education Strategy for the watershed residents that explains the reasons that BMPs are being installed and the overall benefits of maintaining clean surface water.	1.3.3, 1.5.3, 1.7.1, 1.6.2, 4.2.3, 4.3.3, 4.4.1, 6.2.1, 7.1.3, 7.2.1
Task 13:	Work with local municipal governments to review and modify existing ordinances and develop new ordinances that will help to maintain and protect the long-term surface water quality in the watershed.	1.2.6, 1.4.2, 4.2.2, 4.3.1, 6.1.5, 6.1.7
Task 14:	Report progress, successes, and shortfalls to the appropriate agency or funding source.	
Task 15:	Evaluate the entire watershed project or individual BMP sites in a suitable method determined prior to implementation.	

VII

Systems of Best Management Practices Needed

Several categories of sites were identified to receive Best Management Practices (BMPs) to remediate pollutant concerns in the Critical Areas. The pollutants addressed by these BMPs include sediment, nutrients, hydrologic flows, etc. These categories of BMPs that address the Sources of these pollutants include: ***Urban/stormwater, Streambank Erosion, Recreation Trails, Transportation Zones, Residential Riparian Corridors, and Agriculture.*** These BMP sites, their pollutant concerns, and pollutant sources are summarized in Figure 25 below. See Appendix K for BMP photos and plans.

Figure 25: Systems of Best Management Practices with Costs and Timeline

Category	Site/Rank	Project Name	Partners	Proposed BMP	Timeline	Cost
Urban Stormwater	1	White Creek	City of Norway, local organizations, NRCS	Critical area treatment, streambank stabilization, sediment trap, mulch, seed, sood, trees, shrubs & groundcover	Year 1	$70,000.00
	2	White Creek Stormwater Sediment Basin	City of Norway, NRCS	Critical area treatment, grade stabilization, riprap, stabilized outlet, stormwater conveyance channel, detention basin	Year 1	
	3	Gunville Trucking-Grade Stabilization Structure	Private Landowner	Diversion Ditch, sediment basin, rock chute, infiltration basin	Year 1	$22,000.00
	4	U.S. 2 Terraced Land Stormwater	MDOT, City of Iron Mountain, Private	Lawn Maintenance, Grassed waterway, Stabilized outlet, Stormwater conveyance channel, Detention basin, Parking lot storage, Wet detention basin, mulch, seed & sodding	Year 1	$25,000.00
	5	Dickinson Co. Healthcare System	Dickinson Co. Healthcare System	Lawn Maintenance, Grassed waterway, Stabilized outlet, Stormwater conveyance channel, Detention basin, Parking lot storage, Wet detention basin, mulch, seed & sodding	Year 1	$25,000.00
	6	Lofholm's Building Supply	Private Landowner	Critical area treatment, diversion, riprap, stabilized outlets, stormwater conveyance channel, subsurface drain, extended detention basin, infiltration basin, mulching, seeding	Year 1	$30,000.00

	7	Bob's Homes & Wally's Auto Salvage	Private Landowner	Diversion, grade stabilization structure, riprap, stabilized outlet, stormwater conveyance channel, extended detention basin, sediment basin, mulching & seeding	Year 2	$33,000.00
	8	BP Gas Station Runoff	Private Landowner	Critical area treatment, diversion, riprap, stabilized outlet, stormwater conveyance channel, seed & mulch	Year 2	$7,000.00
	9	NE Quad. Breitung Rd. & Poor Farm Creek Stormwater	Private Landowner	Critical area treatment, streambank stabilization, riprap, stabilized outlet, diversion, detention basin, infiltration basin, mulching, seeding, trees, shrubs, & ground crover planting	Year 2	$4,000.00
	10	U.S. 2 & Quinnesec Fumee Creek Detention Pond	Dickinson Co. Road Commission, MDOT	Critical area treatment, grade stabilization structure, stormwater conveyance channel, extended detention basin, mulching and seeding	Year 2	$6,000.00
	11	Lake Mary Stormwater Outlet at the School	City of Norway	Riprap, stabilized outlets, stormwater conveyance channel, detention basin, mulching & seeding	Year 3	$6,000.00
	12	Timberlane Subdivision Expansion Stormwater	Private Lanowner	Lawn Maintenance, check dam, diversion, grassed waterway, riprap, stabilized outlet, stormwater conveyance channel, 2 stage extended detention basin, infiltration basin, seeding, mulching, trees, and shrubs.	Year 3	$12,000.00
	13	NW Quad. Breitung Road & Poor Farm Creek Stormwater & Rock Chute	Private Lanowner	Critical area stabilization, streambank stabilization, riprap, stabilized outlet, diversion, detention basin, infiltration basin, stormwater conveyance channel, mulching, seeding, trees, shrubs, & ground cover planting.	Year 3	$4,000.00
	14	Lake Mary Stormwater Runoff Chutes	City of Norway	Shoreland stabilization, riprap, grade stabilization structure, stabilized outlets, detention basin, mulching, and seeding	Year 3	$25,000.00
	15	Kingsford Wetlands for Stormwater Treatment	City of Kingsford	Constructed wetland use in Nonpoint Source Control, stabilized outlet, seeding, mulching, trees, shrubs & groundcrover planting, or extended wet detention basin	Year 3	$70,000.00
				Estimated Catgory Total:		**$339,000**

Transportation	1	South Breitung Road Ditch	Dickinson Co. Road Commission	Slope stabilization, check dam, riprap, stormwater conveyance channel, grassed waterway, infiltration basin, detention basin, geotextile, seeding, mulching.	Year 1	$18,000.00
	2	Maple Leaf Kennel Driveway	Private Landowner	Asphalt driveway, asphalt curbs, slope stabilization, riprap, setting proper grade and slope direction, seeding, mulching	Year 1	$14,000.00
	3	North Breitung Road Ditch	Dickinson Co. Road Commission	Check dam, grassed waterway, stormwater conveyance channel, detention basin, stabilized outlet, riprap, geotextile, seeding, mulching, regrading slope direction	Year 1	$7,000.00
	4	Fumee Creek & Private Drive Road Crossing	Private Lanowners	Critical area treatment, streambank stabilization, riprap, watercourse crossing	Year 2	$11,000.00
	5	Pellegrini Farm Creek Crossing	Local organization, City of Norway, Trout Unlimited, Private Landowner	Cirtical area stabilizaton, streambank stabilization, riprap, watercourse crossing	Year 2	$13,000.00
	6&7	SW Quad. HW 141 & Breitung Road - North & South Poor Farm Creek Crossing	Private Landowner	Critical area treatment, streambank stabilization, riprap, watercourse crossing	Year 2	$8,000.00
	8	Pier's Gorge Road Crossing	Dickinson Co. Road Commission	Critical area treatment, streambank stabilization, riprap, watercourse crossing	Year 2	$8,000.00
	9	Kimberly Road & White Creek Crossing	Dickinson Co. Road Commission, City of Norway	Critical area treatment, streambank stabilization, riprap, watercourse crossing	Year 2	$20,000.00
	10	Timberlane Subdivision Gravel Road to Expansion	Private Landowner	Critical area treatment, streambank stabilization, riprap, watercourse crossing	Year 3	$8,000.00
	11	Holy Spirit School Driveway & White Creek Crossing	City of Norway and Holy Spirit School	Critical area treatment, streambank stabilization, riprap, watercourse crossing	Year 3	$18,000.00
	12	Forest Road & White Creek Crossing	Dickinson Co. Road Commission	Critical area treatment, streambank stabilization, riprap, watercourse crossing	Year 3	$18,000.00
	13	Fox Ranch Drive & Fumee Creek Crossing	Dickinson Co. Road Commission	Install blacktop curbin, critical area treatment, streambank stabilization	Year 3	$2,000.00
				Estimated Category Total:		**$145,000**
Recreation Trails	1	Fumee Falls Roadside Park Stabilization	MDOT	Staircase, critical area treatment, riprap, mulching, seeding, trees, shrubs, & other native vegetation to stabilize slopes and direct foot traffic to specific areas	Year 1	$50,000.00

	2	Gunville Fumee Creek ORV Crossing	Private Landowner	Critical area stabilization, slope/shoreline stabilization, diversion, riprap, topsoil, seeding, mulching, traffic blocks	Year 1	$5,500.00
	3	Highway 8 White Creek Pedestrian Bridge	City of Norway	Critical area treatment, riprap, geotextile, streambank stabilization	Year 3	$2,000.00
				Estimated Category Total		**$145,000**
Residential	1	Pollard's Riparian Filter	Private Landowner	Critical area treatment, filters, buffer strip planting of native flowers, grasses, shrubs, trees and ground cover	Year 2	$5,250.00
	2	Cowboy Lake & Menominee River Riparian Filter/Corridor	Private Landowner	Critical area treatment, filters, buffer strip planting of native flowers, grasses, shrubs, trees and ground cover	Year 2	$3,000.00
	3	White Creek Purple Loose Strife Removal	City of Norway & School	Removal of non-native species & Critical area planting	Year 1	$500.00
				Estimated Category Total		**$57,500**
Streambank/Shoreline Stabilization	1	White Creek Brush Bundles	City of Norway, Trout Unlimited, Schools, County	Brush Bundles, Brush Mattresses, trees, shrubs, & ground cover	Year 1	$5,000.00
	2	Gunville Sediment Trap	Gunville Trucking	In-stream sediment trap, Critical Area Stabilization, seeding & mulch	Year 1	$4,500.00
	3	White Creek Riffle & Bend	City of Norway, Holy Spirit School, Private	Coconut Biber Biologs, Boulder cluster to form riffle, critical area planting	Year 1	$7,500.00
	4	Menominee River Recreation Area Riverbank - 2 sites	City of Kingsford	Various streambank, slope, or shoreline stabilization techniques, critical area stabilization, riprap, geotextile, topsoil, seeding, mulching & soil bioengineering	Year 2	$18,000.00
	5	Holy Spirit/Norway Streambanks - 2 sites	City of Norway, Holy Spirit School, Private Landowner	Various streambank, slope, or shoreline stabilization techniques, critical area stabilization, riprap, geotextile, topsoil, seeding, mulching & soil bioengineering	Year 3	$2,000.00
	6	NE Quad. Streambank of Breitung Road & Poor Farm Creek	Dickinson Co. Road Commission, Private Landowner	Various streambank, slope, or shoreline stabilization techniques, critical area stabilization, riprap, geotextile, topsoil, seeding, mulching & soil bioengineering	Year 3	$1,000.00

	7 & 8	Norway Waste Water Treatment Plant Streambanks - 2 sites	City of Norway	Various streambank, slope, or shoreline stabilization techniques, critical area stabilization, riprap, geotextile, topsoil, seeding, mulching & soil bioengineering	Year 3	$1,750.00
	9	SW Quad Streambank of Pedestrian Bridge & White Creek	City of Norway	Various streambank, slope, or shoreline stabilization techniques, critical area stabilization, riprap, geotextile, topsoil, seeding, mulching & soil bioengineering	Year 3	$500.00
	10	SW Quadrant Streambank on Hwy 8 & White Creek	Dickinson Co. Road Commission	Various streambank, slope, or shoreline stabilization techniques, critical area stabilization, riprap, geotextile, topsoil, seeding, mulching & soil bioengineering	Year 3	$6,000.00
	11	Southwest Streambank of Kimberly Road & White Creek	City of Norway	Various streambank, slope, or shoreline stabilization techniques, critical area stabilization, riprap, geotextile, topsoil, seeding, mulching & soil bioengineering	Year 3	$1,250.00
	12	Timberlane Creek Streambank West of Gravel Road	Private Landowner	Various streambank, slope, or shoreline stabilization techniques, critical area stabilization, riprap, geotextile, topsoil, seeding, mulching & soil bioengineering	Year 3	$2,500.00
				Estimated Category Total		**$50,000**
Mining	3	Aragon Mine Pump Changes	City of Norway	Regulate pumping operations	Year 2	**$12,000.00**
Agriculture	1	Oak Crest Stables Composting Facility	Private Landowner	Horse Manure Composting Facility, diversion, grassed waterway, buffer/filter strips, geotextile, seeding & mulching	Year 1	$140,000.00
	2	Dickinson Co. Fairground Animal Waste System	Dickinson County	Animal Waste System, Filter/buffer strip, grassed waterway, geotextile, diversion, seeding & mulching	Year 1	$50,000.00
	3	Daegner Farm Animal Waste System	Private Landowner	Animal Waste System, Filter/buffer strip, grassed waterway, geotextile, diversion, seeding & mulching	Year 2	$35,000.00
				Estimated Category Total		**$235,000**

VIII

Addressing Local Ordinances, Programs

State Laws

The waters of the Fumee Creek Watershed are protected under several state regulations. They are housed under the Natural Resources and Environmental Protection Act; Act 451 of the Public Acts of 1994, as amended. The applicable parts of this legislation are:

PART 31	Water Resources Protection
PART 87	Groundwater and Freshwater Protection
PART 91	Soil Erosion and Sedimetation Control
PART 95	Watercraft Pollution Control
PART 301	Inland Lakes and Streams
PART 303	Wetlands Protection
PART 305	Natural Rivers
PART 307	Inland Lake Levels
PART 309	Inland Lake Improvements
PART 311	Local River Management
PART 315	Dam Safety
PART 365	Endangered Species Protection

The above state laws are administered by the Michigan Department of Environmental Quality, whose most local field office is in Crystal Falls.

Health Code

County Health Code regulations offer some of the more consistent water quality protections_within the watershed and County. These regulations fall under the Superior Environmental Health Code as defined by Section 2441 of Michigan Public Health Code, Act 368, Public Act of 1978. The code was effective March 13, 1998 and is enforced by the

Dickinson-Iron Health Department. Several of the regulations pertain to water quality, most of which have to do with the location of septic systems. Septic systems, vaulted privies and absorption systems must be located a minimum of 50 feet from residential wells and 75 feet from Type IIb non-community and Type III water supplies. These same systems must be a minimum of 75 feet from surface waters. There must be at least 48 inches of soil/rock between a septic system and the seasonal high water table. For homes with three bedrooms or less, the minimum size of septic tank is 1,000 gallons. For each additional bedroom, 250 gallons must be added to the capacity. Homes with garbage disposals require an additional 250 gallons capacity as well. More detailed information and permits can be obtained from the Dickinson-Iron Health Department.

Stormwater Ordinances

Urban stormwater has been sited in this study as a major source of non-point source pollutants, including sediment, nutrients, pathogens and warmed water. Opening the discussion about stormwater management with various governmental bodies has been an important product of the Fumee Creek Management Plan process. There is much work ahead relating to the development and coordination of stormwater regulations and the following discussion sets the stage for those efforts:

Dealing with the overland flow of water during precipitation events or snow melt has likely been an issue for many centuries prior to the present time. Maintaining human health, safety, and convenience have been the primary reasons for quickly removing runoff water from areas of development in the past. These same reasons continue to be the most important for runoff control today. However, since the passage of the Clean Water Act in 1972 addressing what we now call stormwater has forced us to look at the control of runoff for additional reasons that impact surface water quality.

Water quality protection laws and regulations set forth by the federal and state governments have been effective at improving several aspects of the quality of water across the country. These laws continue to get stronger and also impact a wider range of contributors. The National Pollution Discharge Elimination System (NPDES) is a permitting process that helps protect lakes and streams from stormwater pollution. Certain industry classifications and developed areas of substantial size are required to obtain a NPDES permit that determines the amount of pollution allowed in discharges to a waterbody. Waste water treatment plants, metal fabrication plants, auto parts salvage lots, and paper mills are examples of industries in the Fumee Creek Watershed that are required to obtain a NPDES permit for their stormwater discharges.

Unfortunately, there are still areas where water quality continues to be degraded due to gaps in the laws where permit coverage or water quality monitoring are not a requirement. Storm sewer discharges from city, township, and individual development sites in the Fumee Creek Watershed are left unregulated by current laws because our communities do not have population concentrations high enough to require stormwater monitoring and limits on pollution discharge. This situation creates a water quality issue in the watershed for two reasons. The first issue is that southwestern Dickinson County is fortunate enough to have good water quality in the majority of waterbodies at the present time. Secondly, our communities have, and will continue to, separate stormwater sewers so that this water no longer receives treatment at a treatment plant and is directly discharged to a body of water.

Cities in the watershed have worked over the past ten years to separate their stormwater sewers from the sanitary sewers. In the past, these two sewer systems were combined and all the water flowed to the treatment plant and was "cleaned" prior to discharging to a stream or river. As development increased so did the amount of impervious surfaces and the amount of runoff directed to storm sewers and the treatment plants. As a result, the waste water treatment plants were overwhelmed with water, could not treat it all, and therefore had to discharge stormwater and untreated sewage directly into surface waters in the watershed. These discharges are regulated by an NPDES permit and the cities must follow certain guidelines during this type of an event. However, because overflows continue to occur, the cities continue to separate the stormwater sewers to prevent future overflows. For complete listings of waste water treatment plant overflow events for the cities of Iron Mountain/Kingsford (discharging to the Menominee River) and Norway (discharging to

White Creek) visit the Michigan Department of Environmental Quality website at www.michigan.gov.

Unregulated stormwater discharges are the single greatest threat to water quality in the Fumee Creek Watershed. Stormwater discharges ranks first as a source for seven of the nine pollutants impacting water quality in the watershed (Figure 10). Urban stormwater ranks as the third most important source for depressed dissolved oxygen pollution and does not impact the exotic species pollutant category. Additionally, stormwater pollution is negatively impacting all nine designated uses and is a contributing factor in all four of the Watershed Critical Area categories discussed in chapter 3.

The significance of the urban stormwater pollution source in the watershed displays the importance of the need for City and Township governments to get involved by creating stormwater management ordinances. The cities of Iron Mountain, Kingsford, and Norway and Breitung Township have all seen increases in development in the past decade and it is not anticipated that this rate growth will cease.

Iron Mountain

The City of Iron Mountain set a priority and has accomplished the difficult task of separating nearly all of storm and sanitary sewers in a relatively short time. The disadvantage that Iron Mountain has is that there is a smaller amount of land that has yet to be developed and has therefore created some difficult stormwater management decisions. These decisions have dealt almost exclusively with where to direct the stormwater and not on improving the quality of stormwater before it reaches a lake or stream.

Iron Mountain storm sewer separation projects have negatively impacted the water quality and caused flooding concerns for Crystal Lake. The last storm sewer project on U.S 2 led to more water discharging to the Chapin Lakes to alleviate flooding pressure on Crystal Lake without first studying the possible impacts that could occur to Lake Antoine due to the Chapin Lake-Hamilton Mine Shaft-Lake Antoine connection. U.S. Highway 2 corridor development on east boundary of Iron Mountain is causing significant impacts to the White Birch Mobile Home Community Lakes (Dawn's Lake) and Poor Farm Creek and has flooded U.S. 2 and business owners at times. At this location the stormwater is crossing political bounds and creates issues in Breitung Township.

Kingsford

The City of Kingsford has worked to separate storm and sanitary sewers at a slower rate that Iron Mountain but continues to make separation projects a priority. Kingsford's disadvantage is that the only water body within city limits to discharge stormwater to is the Menominee River, which makes discharging stormwater sometimes more difficult because it has a longer distance to travel. There is also more land available for development and therefore the possibility for greater stormwater problems in the future. Undeveloped land can also be beneficial to the city as well because there is greater opportunity to better plan for stormwater management.

Kingsford has had some success at preventing direct stormwater discharges to waterbodies without additional treatment. For instance, city developed discharge points flow over a land base for quite some distance before reaching the River if the discharge reaches the river at all. There is one direct discharge stormwater pipe west of the Menominee River Recreation Area Park. The city and the watershed project has identified a type of constructed wetland to receive stormwater inland of the discharge to provide much needed additional treatment prior to discharging to the Menominee River.

Kingsford also has one of the best and most easily visible examples of stormwater management in the watershed located off of East Boulevard behind the ShopKo and JC Penny's developments. The city utilized two large basins to collect stormwater runoff from a large area. High infiltration soil characteristics made this site a good location to utilize infiltration basins that allow stormwater to dissipate into the ground instead of discharging to a waterbody. These basins have not discharged more two or three times in a 15 year time span. In fact, you can drive by these basins during a large rain event and the bottom of the basins will barely be filled.

Norway

The City of Norway has several small lakes within the city limits that do not have creeks as an outlet but some of them are connected to groundwater by underground mining tunnels. Some of this groundwater is then pumped to White Creek via the Aragon Mine Pump. White Creek is a jewel of a resource that flows through a good portion of the city but unfortunately White Creek receives the majority of stormwater discharges from the city and U.S. 2.

Norway has a substantial amount of undeveloped land. Most of this land is less than desirable for development for reasons such as the location of wetlands, steep ground, and productive farm land. The City has seen some development in recent years. Most of the new development has been concentrated around the U.S. Highway 2 corridor, the White Creek corridor, and in the population concentration area associated with these corridors. Stormwater discharges are causing significant negative impacts to White Creek and the lakes through the additions of sediment, nutrients, and increased hydrologic flow.

Breitung Township

Breitung Township has experienced the fastest rate of growth in the Fumee Creek Watershed and it is likely that development will continue in the township. The growth has raised stormwater concerns near U.S. 2 and Fumee Creek, Breitung Cutoff Road, and U.S. 2 near Iron Mountain. An area outside of the watershed is worth mention in this management plan also. Areas around Lake Antoine and adjacent to Iron Mountain City limits is experiencing growth that should also be addressed.

The only storm sewer systems discovered in Breitung Township are located along U.S. Highway 2 flowing east from west of the Iron Mountain boundary. The second storm sewer system flows east to Fumee Creek from the traffic light at Quinnesec-Lake Antoine Road on U.S. 2. As development continues Breitung Township will need to address the installation of storm sewer systems and where they will discharge.

Summary

The Fumee Creek Watershed contains several municipal entities in different stages of growth, development, and infrastructure development. There have been success stories and failures of stormwater management in all of the communities. At the present time there are no rules or regulations in place by the communities that require retention, detention, or treatment of stormwater on a site specific basis for new developments. Instead, municipalities address stormwater issues for new developments on a case-by-case basis if at all. By not requiring individual landowners or developers to address the stormwater produced on their land, the municipalities are left with the burden and cost of establishing the storm sewer network large enough to handle everything within the political boundaries. In the long run it is the citizens that are impacted through higher taxes and the overall decline in the water quality of lakes and streams that everyone owns and has a stake in.

Establishing stormwater management ordinances at any stage of growth or development is a much needed requirement to maintain the good quality lakes and streams present in our communities and improve the quality of others. Taking a proactive approach by preventing flooding and removing sediment, nutrients, and other pollutants from stormwater prior to the discharge to surface waters is the single, most important method of ensuring water quality protection in the Fumee Creek Watershed. The development and implementation of local or watershed based ordinances that establishes requirements for new developments to provide the treatment of the stormwater generated on their property and the slow release of that stormwater to a waterbody or municipal sewer system would not only be a benefit to water quality but to the quality of live in southwestern Dickinson County.

Developing a Stormwater Ordinance

Several municipalities have developed stormwater management ordinances around the country to take a proactive approach not only to alleviate flooding but to maintain and improve the quality of water for the residents that enjoy the lakes and streams for a multitude of reasons. Guidance and information in developing stormwater ordinances can be found in the World Wide Web or by contacting other municipalities that have gone through the ordinance development process. There are several benefits, including savings in cost and time, of drawing on and building on the experience of others. One example would be to contact the nearby Upper Peninsula community of Marquette, MI who has successfully implemented similar stormwater ordinances and can be looked to as an example to build our own, independent success story.

During the Fumee Creek Watershed Project Planning Phase a significant amount of time went into locating and evaluating example stormwater ordinances. The list and description found below were determined to be good components of ordinance language that that would provide water quality and flood prevention benefits. This section is not to be used as a definitive source of information or description to be used in an ordinance. Instead, view this section has important aspects to consider when going through the ordinance development process and use this information as a spring board to determining what to include in the final ordinance language.

Example of Important Points Included in
Sample Stormwater Management Ordinances

Stormwater management areas and facilities shall be designed, constructed, and maintained to prevent flooding and protect water quality. All sites one acre or more that changes the original land cover type or has greater than 10,000 square feet of impervious surfaces will be required to meet the standards specified below:

- After development or land cover change, runoff from the site shall approximate the rate of flow, volume, and timing of runoff that would have occurred following the same rainfall under predevelopment conditions.
- To prevent flooding, all stormwater management facilities shall be designed for, and based upon a 25-year frequency 24-hour duration storm event.
- To achieve water quality improvement, all stormwater management facilities must be designed with sufficient capacity for extended detention or infiltration of a 1-year storm

frequency for 24 hours. (This addresses the most heavily polluted water associated with the "first flush" of water after a storm event)

- An effort should be made to utilize open space or green areas for the percolation of water into the ground.
- It is encouraged to utilize several practices to convey, treat, and store stormwater runoff to improve the success of the sites stormwater management system. (i.e. if one fails, the whole system does not fail)
- Runoff leaving the site shall be controlled to a non-erosive velocity, both during and after construction.
- The design of stormwater management systems needs to be approved by a qualified engineer.
- The landowner will be required to conduct routine check-ups to ensure the facilities are functioning properly, conducting necessary maintenance of stormwater facilities, and providing any future landowners with the history of the stormwater facilities as well as the responsibilities outlined above.
- Standards and specifications for Best Management Practices found in the publication, *The Guidebook of Best Management Practices for Michigan Watersheds,* Michigan Department of Environmental Quality (October 1998), must be used for designing stormwater management facilities.

In short, a stormwater ordinance aims to ensure that project sites maximize on-site percolation of runoff and/or have the capacity to convey or store peak runoff from a storm and release it at a slow rate so as to minimize the peak discharge into storm drains, ditches, and waterbodies. Second, it aims to ensure that a sites runoff is directed or contained so that pollutants contained in the runoff receive treatment prior to entering a waterbody.

IX
Information and Education Strategy

Installing Best Management Practices (BMPs) is not the only action to be taking in safeguarding the surface water resource. Instituting a well-planned and intensive strategy for informing and educating watershed area residents is also a key component of protecting water quality. Educated residents will increase the awareness of the importance of clean water and will also increase the spread of this important information to others and future generations. Construction, vegetative, and, managerial BMPs used in conjunction with the information and education strategy will address long term surface water quality issues.

Several information & education activities have begun during the Fumee Creek Watershed Planning Process. These components should be continued and be complemented by the other activities to improve the public information and education strategy. The following is a list of information and education actions taken and suggestions for future additions. It is suggested that all of the activities that have been completed should continue to occur in order to send a continual message of the importance of clean water and actions that people can take to protect and improve water quality.

Past and Present I & E Activities

Watershed Newsletters

Issues of the *Fumee Creek Crusader* have been mailed out quarterly with the USDA Service Center partners newsletter the *Landscape* and distributed singly at several opportunities. The newsletter includes watershed progress information, future events, meeting times, chances to getting involved, and volunteer activity reports. An educational component about a topic related to water quality has also been included in several of the newsletter issues.

Radio Interviews and Newspaper Articles

The watershed community has been open to allowing the watershed project to distribute information and update residents on an even broader scale than the watershed newsletter through the use of radio and newspapers. Aaron Harper, the News Director at WJNR-101.5 FM has been particularly helpful in airing information about the watershed project. WMIQ, WZNL, and WMIK-FM's News Director, Tom Hill, has also helped by airing volunteer opportunities.

Newspaper staff at the Advertiser, Daily News, and the Norway Current have been instrumental in publishing watershed project articles in a timely manner. All three newspapers have included Watershed Council Meeting announcements, volunteer opportunities, informational and educational articles, and photos and articles about volunteer projects after they were completed.

The importance of watershed resident involvement with the watershed planning process was continually included and stressed in the majority of the articles and public service announcements. Several people contributed information to the planning process by direct contact and involvement gained as a result of the watershed project media coverage.

Web Site

The Fumee Creek Watershed Project can be accessed on the World Wide Web at http://www.dickinsoncd.org/fumeecreek/. The web site has background information about the watershed project, information about the watershed, water quality concerns, pollutant information, educational activities and opportunities, Best Management Practices, issues of the *Fumee Creek Crusader*, and Stormdrain Stenciling information. The web site is a great tool to disseminate information surrounding the watershed project and will continue to provide information to interested individuals.

Watershed Tours

The Dickinson Conservation District holds a "Conservation Tour" every other year and highlights the projects completed and the partnerships required that make them a success. The Fumee Creek Watershed Project has been involved with showing areas of concern in the watershed on the last two occurrences of the tour. In addition, a tour of some of the proposed sites to receive Best Management Practice installations was given to interested members of the watershed and Watershed Council Members.

School Field Trips, Classroom Presentations, and Camp Sanford for area 6th Graders

Reaching school age children with the message about the benefits of clean water and ways that everyone can protect the resource can have long lasting impacts. Instilling an ethic of environmental awareness at an early age may begin a lifetime of effort in maintaining healthy natural resources that benefit everyone.

Informational Displays at Area Events

The Fumee Creek Watershed Project Manager and Dickinson Conservation District Resource Professionals have staffed booths that distribute information about the watershed project and the surface water resource. Attended events include the Dickinson County Home Show, Dickinson County Fair, and the Fumee Lake Natural Area Open House. The Conservation District also kicked off an Annual Open House that was a big success in 2002.

Volunteer Stream Cleanups

In 2001 the Fumee Creek Watershed began an annual stream cleanup campaign to get area residents outdoors and in the water. Over 50 people have participated and removed litter and debris from approximately 2 miles of stream during the three cleanups organized to this point. This is a great way to show people first hand the impacts of stormwater pollution, soil erosion and sedimentation, and the careless disposal of litter and debris.

Storm Drain Stenciling Program

Municipal governments and watershed residents have enthusiastically received the Stenciling Program. The overriding principal of the program is to inform people that stormdrains carry runoff water to lakes and streams and do not receive treatment from a waste water treatment plant before discharge. Students have enjoyed the time out side stenciling storm drains and distributing door hangers that inform residents of actions they can take to reduce the impacts of stormwater pollution on area lakes and streams. The teachers involved in the program have had positive reactions and feel strongly about the important message that the students learn about and bring into the community. Over 210 storm drains in the Crystal Lake subwatershed have been stenciled with the message of "Dump No Waste, Drains to Lake" and the image of a fish. See Chapter IX., Information and Education Strategy, for a more detailed account of this program.

Home*A*Syst and Lake*A*Syst Programs

In the Fumee Creek Watershed, the majority of city boundaries are drained by stormwater systems that connect directly to lakes and streams. Additionally, there are minimal regulations about the proximity of residential structures and waterbodies and that often leads to native vegetation clearing and lot runoff concerns. The Michigan Groundwater Stewardship Program, Michigan State University Extension, and the Michigan Agricultural Environmental Assurance Program developed these programs. Homeowners and property owners are guided through the site assessment process by a resource professional to identify what situations are risks to the surface water and groundwater resources. The programs describe the methods that landowners can improve their methods of things such as fertilizer management, chemical storage, and shoreline vegetation or lawn care.

Enviroscape

The Enviroscape is a trademarked product that gives people the chance for classroom hands on learning in the various fields of natural resource management. Of particular use in the Fumee Creek Watershed would be the stormwater model. This model displays residential areas, a golf course, a wastewater treatment plant, a farm, construction site, and a forest clearing. Household objects and products are utilized to represent pollutants on the land and the participants spray water on the model to see the landuse relationships to stormdrains, lakes, and streams.

Watershed Signs and Identifying Creek Signs

Installing road signs displaying the specific location of creek crossings and watershed boundary signs would be helpful with having residents identify where they live on the landscape and what surface water resources are close by.

Norway Recreation Area/White Creek Channel Restoration/Wetlands Reserve Program

The City of Norway has purchased a 40-acre parcel of property within walking distance of the majority of the city's population. The watershed project has proposed several projects that would benefit water quality (Urban Channel Restoration Sites 1-4) and also a wetland restoration project that would increase wildlife habitat and water quality. The wetland restoration has been proposed for funding under the Federal Wetland Reserve Program and would be installed through a partnership with the USDA Natural Resources Conservation Service, the City of Norway, and the Fumee Creek Watershed Project.

The City of Norway bought this land with the ideas of developing it as a low impact recreation area and will include walking trails through the property as a component of "City of Trails Master Plan. The area schools are located only eight blocks away and would be able to benefit from the educational opportunities at this recreation area. Interpretive trails, informational kiosks, Best Management Practices descriptions, and viewing platforms are all in the plans for this site.

Michigan Department of Transportation's Fumee Falls Roadside Park

The Fumee Falls Park is a heavily visited park directly off U.S highway 2. Visitors to the area stop to see one of Dickinson County's beautiful natural sights and often times take picnics at the park. Watershed residents visit the park for such events as High School Prom pictures, Senior pictures, wedding pictures, and even weddings themselves. The park receives heavy use but lacks the structures to effectively guide visitors up and down the steep slopes directly adjacent to the Fumee Falls. As a result the slopes are composed of severely eroding gullies washing into Fumee Creek and damaging habitat and water quality. The watershed project's goal is to secure funding to install a staircase near the falls to give visitors access to the beautiful upper level waterfalls. Vegetation establishment and slope stabilization is a vital part of the plan for this site. There is a great opportunity to educate the public about the measures taken at the site to preserve water quality, aquatic organism habitat, and natural views and yet continue to provide safe access to park visitors. Using an informational kiosk with descriptions of what has occurred, why it was completed, and before and after pictures would be a great educational opportunity.

Streambank Stabilization Projects

The size and location of streambank stabilization projects in the Fumee Creek Watershed is very conducive to including watershed volunteers and area students in the process. Installation of these types of project is an outstanding way for people to obtain real life experiences protecting water quality and learning construction techniques in the process. Many stabilization methods can be done or assisted by people from ten years old and older. Another benefit is that those residents involved will have connection and a stake in how the watershed is being taken care of.

Best Management Practice Site Visits

The concept of providing watershed residents with a tour of the watershed should be expanded so that participants would really be impacted by what can be accomplished through partnerships in protecting water quality. This informational and educational should only be completed if the watershed partner is willing to participate. The program should start by advertising a one-site tour of a water quality concern in the watershed and that anyone interested is welcome to attend. Bring the attendants to the site and show them first hand what is occurring, what is causing the problem, what the water quality impacts are, and explain how it is going to be fixed. Then, after the Best Management Practices area installed and the construction site is stabilized and vegetated bring the original participants back to show them how it works now and explain again how it was completed.

Native Plant Filters & Corridors

This type of proposed Best Management Practice requires very little actual construction activity but instead in requires a significant amount of personal handwork and labor. Volunteer labor is a very effective method to complete a project of this nature. Installing filters and corridors is a method of replacing the traditional turf grass ground cover that requires continual maintenance and upkeep to native shrubs, grasses, and flowers. The native vegetation is much more effective at stabilizing banks, combating drought conditions, providing wildlife habitat, filtering nutrient rich lawn runoff, and they require much less maintenance over a longer time frame. Utilizing volunteers to install projects of this scope teaches the reasoning behind the positive impacts of the Best Management Practice and possible negative impacts of a turf grass shoreline. An added benefit is that more people learn how the practice is installed and may install one themselves or help someone else install a riparian filter or corridor without requiring cost share assistance.

Publicity Materials

The watershed project will continue to develop and purchase items that promote watershed involvement, partnerships, and water quality in general. T-shirts, hats, and static cling on stickers have already been distributed to watershed residents.

Summary of Public Participation

The public was welcome in the evolution of the Fumee Creek Management Plan. A complete list of partners follows, which includes the private citizens, public agencies, and technical resources who attended Watershed Advisory Council meetings, consulted with the project manager in developing appropriate Systems of Best Management Practices to address various watershed concerns, and provided letters of support for the installation of these BMPs on their land. In addition, a wider audience was reached thanks to free publicity received from local radio station WJNR and both local Newspapers. The watershed maintained a website on the Dickinson Conservation District Home Page which gave the project national exposure. Inserts in the Conservation District's Newsletter *The Landscape*, reached 1700 readers eight times during the two year planning phase. Readers were kept updated on the progress and activities in the watershed, highlighting resource concerns and BMP systems as well as inviting participation.

Copies of the management plan were submitted for review/comment to several key Advisory Council members and was available for review at the Conservation District office.

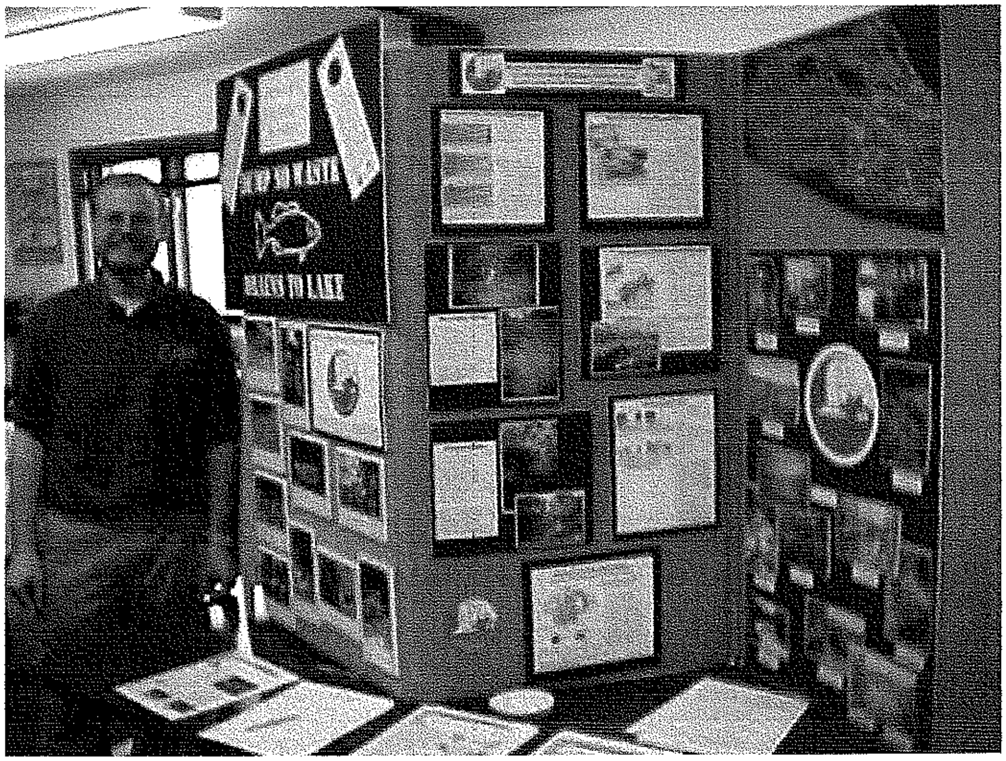
Fumee Creek Watershed

Fig. 26 : Partners and Advisory Council

Robert Szews – Wisconsin Electric
Bill Marchetti, Dickinson Co. Controller
Cliff Kahl, MSU Extension
Darryl Wickman, City of Kingsford
Miriam Belding – Citizens for Clean Air
Del Siler – MDNR Fisheries
Beth & Bill Marchetti – Audubon Society
Earl Bass – USDA Farm Service Agency
Mark Isackson – City of Norway
Harry Kleinman – Well Driller
Quentin Peterson – Citizen
Tim Hammill – Dick. Co. Road Commission
Ron Matonich – Dick. Co. Health Dept.
Kristie Sitar – MDEQ
Bill Scullon – MDNR Wildlife
Dave Litner – International Paper Co.
Bill Rabenberg – Breitung Twp.
Bernier Huetter – NRCS
Edie Raffin – Dick. Co. Solid Waste Mgt.
Jim Pawlowicz – MDA
Jim Nicolas – Fumee Lake Commission
Charles Erickson – Dick. Co. Road Comm.
Jim Carron – MDEQ
Deb Begalle – MDNR Forest Management
Mark Ponti – International Paper Co.
Leonard Bal – Norway Township
Pete Schlitt – Dick. Co. Emg. Preparedness
Randy Wilkinson – U.P. RC&D
Dave Pajula – Dick. Co. Road Commission
Sue Pope – Fumee Lake Commission
Lisa LaCosse – Kingsford High School
Tom Nemichek – UPTRA
Richard Rahoi – Dick. Co. Drain Commissioner
Brooks Aviation Services
Kiwanis Ski Club
Kingsford Broach & Tool, Inc.
Wisconsin Central LTD Railroad
Tourism Assoc. of Dickinson Co.
Timberstone Golf Course
Shirley Mande – ZONTA Club
Rhonda Carey – Iron Mountain High School
Tom Bedard – Norway Civic Club
Dick Bedard – Dickinson Co. Fair Board
Superior Aviation
Time Klenow – U.P. Engineers & Architects
Bill Rice – Breitung Twp. Schools
Escanaba & Lake Superior Railroad
Bill Taft – MDEQ
Pine Grove Country Club
Tony Zygiel – Norway/Vulcan Schools
Dave Gillis - CUPPAD
James Urbany – City of Iron Mountain
Fayas & Sons, Inc.
Twin Pine Lumber Co.
Larry Seratti – Nicolet Beverage Co.
Chicago & Northwestern Railway
Norway Mountain Ski Resort
Dickinson Co. Racing Association
Great American Disposal Co.
Danielson Greenhouse
Grede Foundries
K-Mart
Lake Shore, Inc.
David Kurtz – Werner Electric Supply Co.
CJ Graphic
Dickinson Co. Hospital System
Iron Mountain Waste Water Treatment Plant
Marvin Johnson – Dick.Conservation District
Lodal, Inc.
Culligan Water Co.
ShopKO
Bob's Homes
Dickinson Homes
Trico Opportunities
Robert Witter, Iron Mt. Board of Education
Todd Battle, Dick Area Economic Dev. Allia.
Kingsford Waste Water Treatment
Ron Ball - Dick. Conservation District
North Star Print Group
Consolidated Paper Mill
WalMart
Nelson Paint Co.
Town & Country Ford
Danita Larson – Oak Hill Internet
Veterans Administration Hospital
Norway Waste Water Treatment Plant

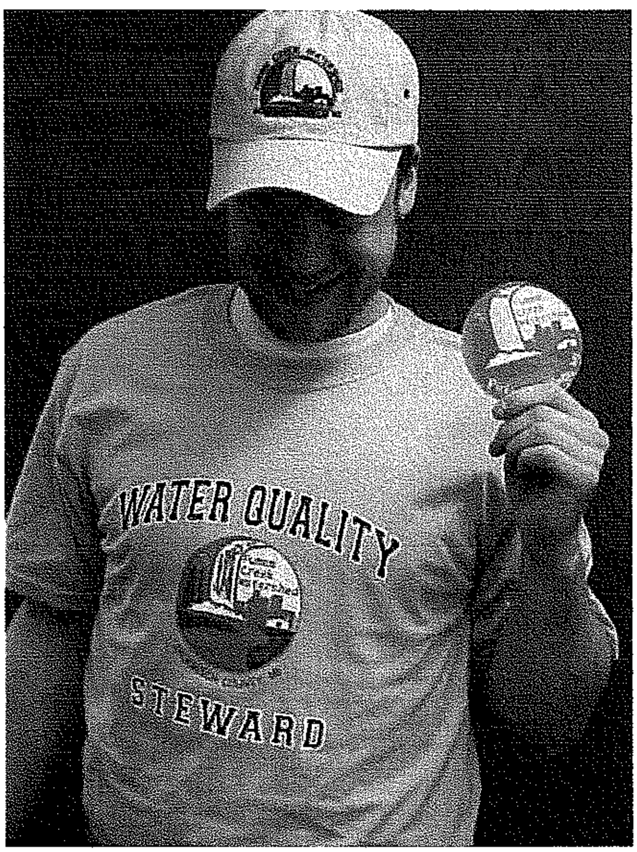
Education Activities

District Open House & Fair Displays

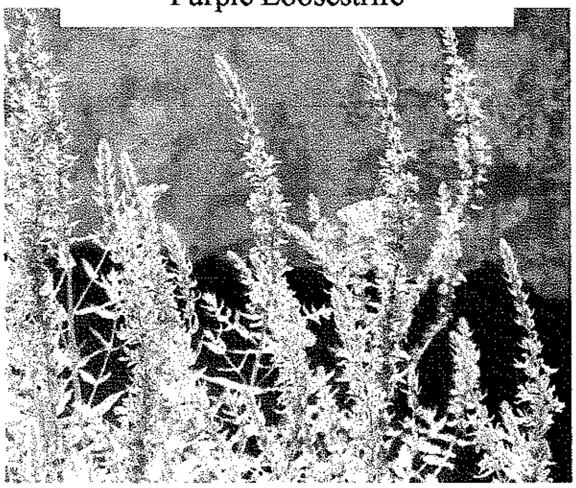


Promotional Items

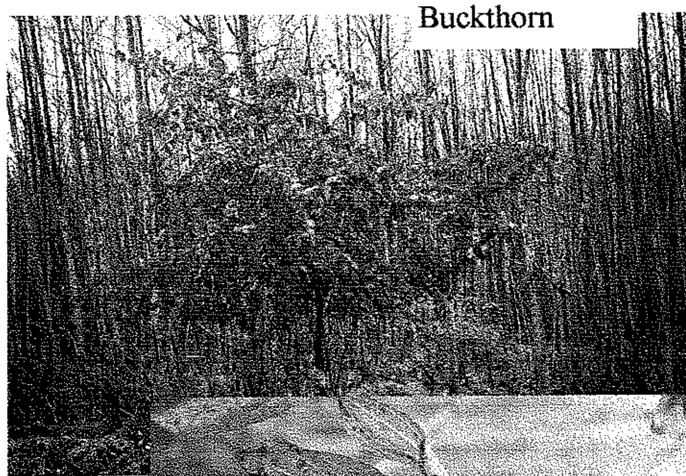
Storm Drain Stenciling

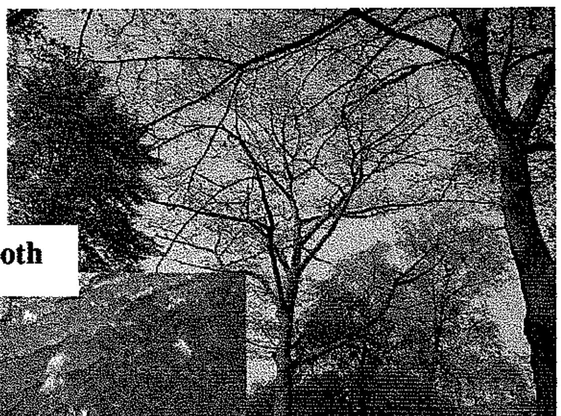


Purple Loosestrife

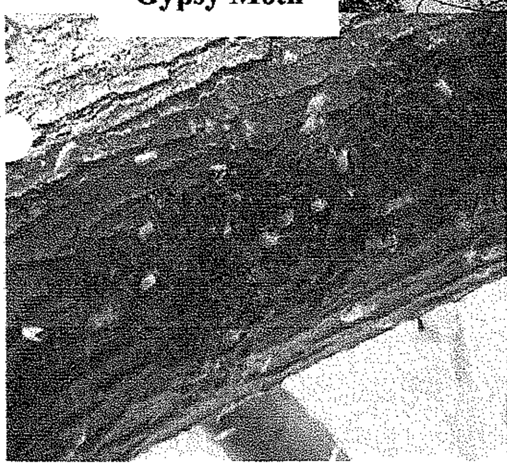


Buckthorn





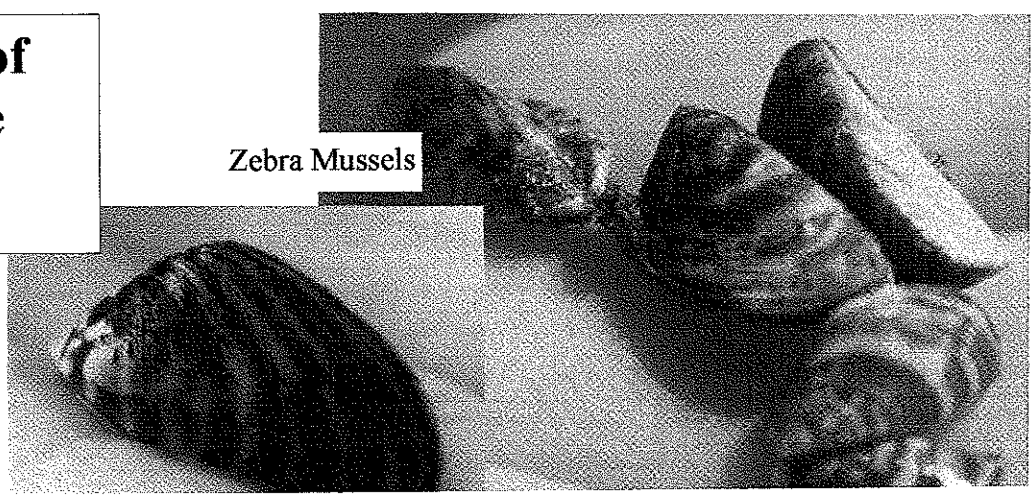
Gypsy Moth

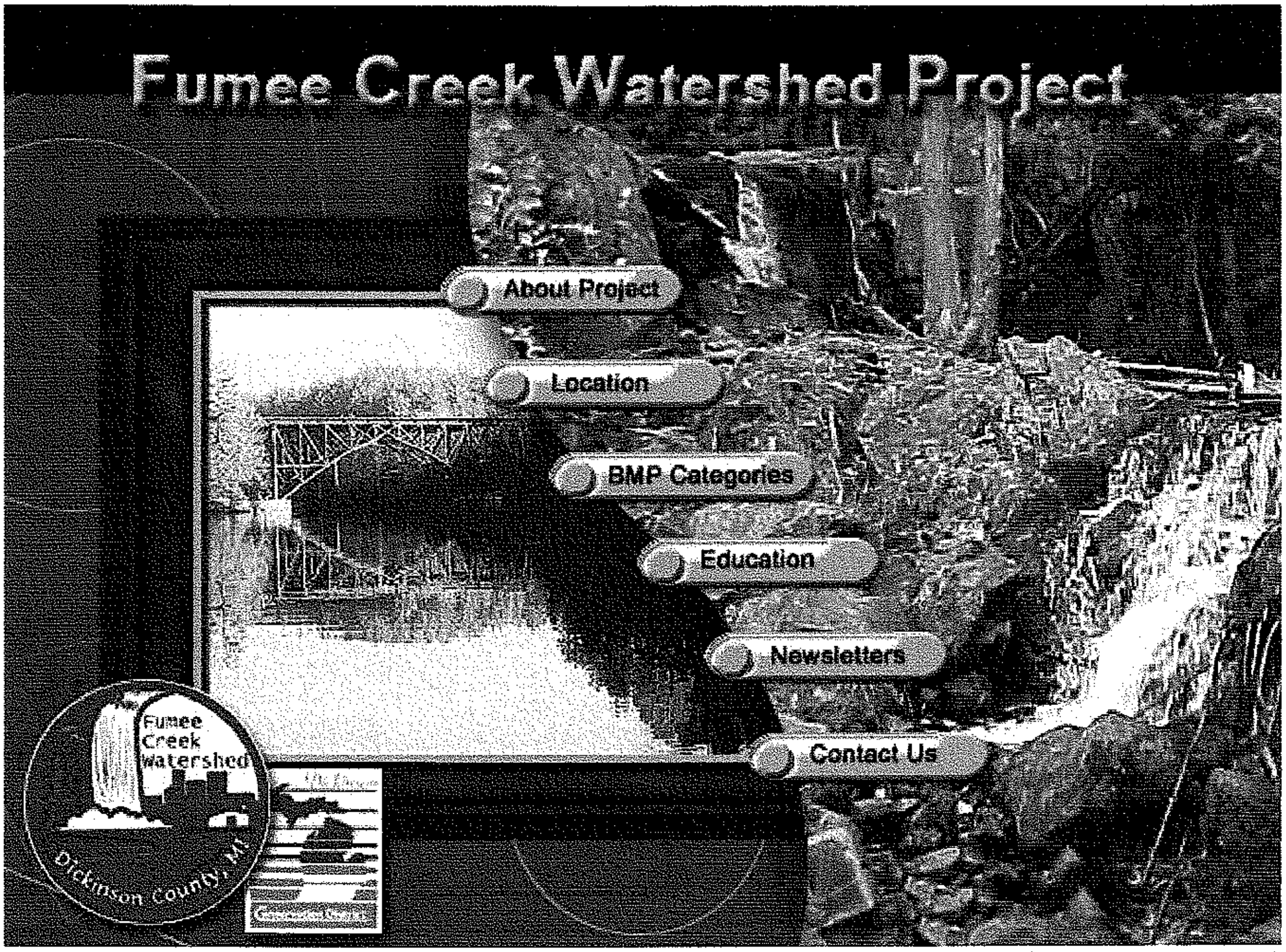


Eurasian Milfoil

Exotic Species of Concern in the Watershed

Zebra Mussels





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X

Evaluation Process

Evaluation

The overall success of the project will be evaluated by:

- Before and after photographs
- A list of implemented Best Management Practices
- The calculation of pollutant load reductions
- Meetings with Steering Committee before, during and following implementation
- Feedback from partners involved during and following implementation
- Monitoring of aquatic life within streams following implementation
- Operation and Maintenance inspections following implementation

U.P. Engineers and Architects, NRCS, DNR Fisheries and other partners have been consulted about the Best Management Practices proposed for each site and will evaluate them upon completion. The number of identified projects that are completed by the end of the implementation phase and how closely BMP installation followed original cost estimates will also measure successes.

Project partners will be closely involved in the final selection of the Best Management Practices selected and will participate in the construction phase of the practices. Project partners will receive a survey to evaluate their impressions of finalized BMP projects and their feelings about the process of working with the Fumee Creek Watershed Project Grant. Evaluation materials will be included in the final report and given to project partners and the DEQ.

Volunteer groups, such as Girl Scouts and High School students, will continue to provide limited water quality monitoring within the watershed. The volunteer groups will focus on the relative abundance and diversity of aquatic insects utilizing GLEAS Procedure #51 at pre-selected sites. They will be comparing their results with data collected prior to the project implementation phase. A DEQ-approved QAPP will be developed for any sampling activities taking place within the watershed.

An annual Operation and Maintenance inspection will be conducted to evaluate the integrity and function of each Best Management Practice. Results of these inspections will be shared with the landowners, partners, and DEQ.

XI

Water Quality Summary

Analyzing chemical and physical water quality characteristics was one method of inventory used during the Fumee Creek Watershed Planning Project. Five sampling dates occurred during this two-year time span and these dates covered the primary sampling stations established in the watershed. Two other sampling dates were driven by the need for extra data for some of the critical areas identified in the watershed. The first additional water quality sampling date included the U.S. Highway 2 Corridor area that discharges to Poor Farm Creek just east of the Iron Mountain and Breitung Township boundary. The second date was to test for heavy metal presence within the bottom sediments of Crystal Lake. The samples were analyzed by the Fumee Creek Watershed Project Manager and also by White Water and Associates in Amasa, Michigan.

Results of water quality sampling reveal the status of a particular waterbody as only a snapshot in time. The five sampling dates competed will not show definitive trends in water quality. Instead, the data collected is intended to be used for educational and awareness purposes as well as historical information from which future data can be compared. In order to make conclusive statements based solely on water quality testing a more rigorous monthly or bi-monthly sampling schedule should be implemented.

The following statements are based on the results of the water quality data presented on pages 69-71 as well Appendices D, E, F and the information collected during the visual inventory of the watershed.

Temperature

- Crystal Lake, Poor Farm Creek, sections of White Creek, Lake Mary, Strawberry Lake, and, Cowboy Lake have all been recorded above the maximum monthly temperatures stated under MDEQ standards in Figure 14, section IV of the Management Plan.

See Appendix G for more detailed warm season temperature information for three creeks in the watershed. A reason for high temperature levels in Cowboy Lake is largely unknown. Possibilities include sampling shallow water areas, very little water movement in or out of the lake, and loss of riparian vegetation and shade. It is likely that the other five waterbodies in this list are seeing the temperature increases as a result of large amounts of stormwater discharging to them. Loss of riparian vegetation and lack of inlets and outlets into the lakes may also be impacting temperature raises.

Dissolved Oxygen (DO)

- DO in the watershed generally remained above the 7 mg/l requirements of coldwater fish species. The Aragon Mine Pump and stormwater discharge area at U.S. Highway 2 on White Creek is reason for concern. When the mine pump is turned on, the DO content of that water is extremely low remains between 1 and 2 mg/l during end-of-pipe discharge. When the discharge is mixed with creek water the DO continues to be depressed to under 5 mg/l downstream to the Kimberly Road crossing. Low DO degrades the quality of water and fish habitat, reduces and changes benthic macroinvertebrate populations, and can act as a barrier to fish migration while the Aragon Mine Pump is operating.

Dissolved Oxygen Saturation is the amount of oxygen that the water can hold at the currently recorded temperature. The equation used to calculate this number is
14.652-(0.41022*Temp °C)+(0.007991*(Temp °C^2))-(0.000077774*(Temp °C^3)).

Dissolved Oxygen Deficit is the difference between the DO at saturation and the actual DO measured. Watershed results remained between 0 and 3 mg/l, higher levels may indicate that there are other problems in the waterbody. White Creek sample sites at U.S. 2 and Kimberly Road had very high DO deficit results. Crystal Lake and Strawberry Lake showed higher DO deficit levels as well.

Biological Oxygen Demand (BOD)

- BOD results greater that 4 mg/l indicate that there may be issues with excessive plant and algae growth or large amounts of microorganisms using oxygen to decaying large amounts of organic matter. Sources of pollutants include urban stormwater discharge, riparian runoff, fertilizer inputs, and organic matter additions. Crystal Lake, White Creek, Strawberry Lake, Strawberry Creek, and Cowboy Lake all recorded BOD levels greater than 4 mg/l.
- The U.S. 2 Corridor sampling date for a rain event yielded high BOD levels at every stormwater discharge point that was sampled. These results show the significant impacts that occur during storm events where there is a stormwater discharge. The cumulative impact of stormwater pollution on a waterbody increases with every stormwater discharge.

Ammonia Nitrogen remained below 0.325 ppm indicating that there is not a significant source of human wastes from leaking septic systems or animal wastes.

Nitrate Nitrogen

- Nitrate levels over 4.2 ppm can negatively impact many fish species. Poor Farm Creek and Jones Creek had occasional levels less than 10 ppm. All sampling stations on White Creek have shown fluctuating nitrate results from 0 ppm to 28.4 ppm using the test kits. The White Water Associates lab reported results from 0.6 to 8.4 ppm. The differing results of these methods indicate that the water chemistry in White Creek may be creating overly high nitrate results. The key in this situation is that the test kits revealed a water quality concern that was cost efficiently supported by further results from White Water Associates. Testing exclusively with the laboratory would have been extremely costly if conducted at all sites throughout the watershed. A conclusive source of the excessive nitrate in the waterbodies is unknown.

Phosphate

- The recommended maximum levels of phosphate are 0.1 to 1.0 mg/l. Crystal Lake, Poor Farm Creek, Jones Creek, White Creek, Strawberry Lake and Creek, and

Cowboy Lake all had phosphate results of 0.1 ppm or greater with the test kits. White Water Associates results ranged from 0.02 to 0.23 ppm in White Creek. U.S. 2 Corridor storm event total phosphate levels were as high as 0.52 and 0.34 ppm for Dickinson County Healthcare Systems lawn runoff and Kmart stormwater runoff respectively.

pH

- Values of 6.5 to 8.5 are the recommended tolerance range for most freshwater fish species. Fumee Creek Watershed pH results that were collected with the use of pH meter ranged from 6.73 to 8.76 for lakes and streams. These results are no indication of pH concerns in the watershed.

Conductivity

- Conductivity measures the ability of water to conduct an electric current. Conductivity increases with the addition of dissolved solids and may be harmful to fish if levels exceed 2000 umho/cm. Jones Creek had consistently high conductivity results over 1000 umho/cm possibly as a result of dissolved substances in groundwater coming from the closed Central Landfill in Breitung Township. Crystal Lake and White Creek had spikes in conductivity after a rain event sampling on 5/30/01.

Total Hardness

- Total hardness for creeks in the Fumee Creek Watershed ranged from 120 to 430 ppm $CaCO_3$. Lakes in the watershed had total hardness results from 16 to 100 ppm $CaCO_3$.*

*Concentration mg/L CaCo3

0-75 mg/L	soft
75-150 mg/L	moderately hard
150-300 mg/L	hard
300 mg/L	very hard.